The Dock and Harbour Authority

No. 268. Vol. XXIII. Edited by BRYSSON CUNNINGHAM, D.Sc. B.E., F.R.S.E., M.Inst.C.E. FEBRUARY, 1943

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Editorial Comments

The Port of Trieste.

The Port of Trieste, lying at the head of the Adriatic Sea, in an embayment at the North-eastern extremity formed by the Gulf of the same name, has had a long and chequered history, the course of which is outlined by Mr. Bowen in an article in this issue. Located practically on the boundary of two competitive, when not actually antagonistic, European States, it has been a bone of contention between them both. Austria has possessed it in the past, but Italy has secured it for the time being, though the sovereignty of the latter is almost certain to be challenged and probably annulled at the conclusion of the present hostilities. In the readjustment of national boundaries it may be well be the policy of the Allied Powers to reconstitute the ancient dominion of Austria, in which case it will be necessary to provide it with a port as an outlet for its commerce.

Even at the present time, Italian hold on the port is none too secure. It is rumoured that Hitler has covetous leanings towards the incorporation of Trieste in the German Reich, and if he feels sufficiently interested, he is not likely to be deterred from predatory action by consideration for the feelings of his erstwhile fellow-dictator, now sunk to the level of a vassal. The appropriation of the port would give the Reich a valuable key to Mediterranean trade.

The vicissitudes of ownership of Trieste bring to mind the strangely eventful episode in the history of the nearby port of Fiume, which is subject to the same conflicting political interests. It will be recalled that just after the last Great War, the erratic and hot-headed Italian poet, Gabriele D'Annunzio, dissatisfied with the progress of the negotiations for the absorption of Fiume in the Italian regime, suddenly marched into the place at the head of a brigade of Grenadiere and constituted himself its Regent or Dictator. For a period of fifteen months he defied the Italian Government and the European Powers. Then he had to retire and subside into obscurity.

Post-War Port Development.

In continuation of our observations in a previous issue on the subject of post-war planning, it is desirable to consider one very important respect in which future shipping policy must have an undoubted influence on post-war schemes of port expansion. At the same time, although the immediate agency is shipping, the primary cause lies in the direction of air transport. The impetus given by the war to aviation and the tremendous expansion in size and speed of aircraft make it impossible to disregard the effect of these on transport by water. It seems fairly generally conceded in well-informed shipping circles that the high-speed passenger luxury liner is a thing of the past. Those who seek rapidity of transit between distant places will go by air, regardless of any question of cost. "Millionaire" suites, if the demand for them survive, on ocean liners will be limited to pleasure cruises, in which time is of little or no account. Hitherto, vessels of the luxury class have been mainly of mammoth size requiring correspondingly ample port accommodation, not least as regards graving docks for their reception for the purpose of overhaul and repair. With the withdrawal of the demand for travel in such vessels, size should tend to decrease to more modest dimensions and one of the greatest bugbears of the modern dock engineer will disappear.

Yet another consideration is the fact that owing to the losses sustained in U-boat warfare, the British Mercantile fleet will be greatly depleted after the war. It will inevitably be less in numbers and in tonnage than in pre-war days, in spite of recent intensification of shipbuilding. At the same time, there is every hope that this reduction will be merely temporary, so that eventually there will be scope for further port expansion.

But the effect of air competition on passenger traffic and passenger vessels will be no less felt in regard to cargo vessels. Mails and valuable freight already go largely by air and the air freighter though still a vision of the future, is on the way to materialisation, as is evidenced by the fact that an order for one hundred 70-ton air cargo liners is actually in hand in Mr. Henry Kaiser's yards in the United States. He has stated that at no distant date he will seek United States Government sanction for the mass production of the largest cargo aircraft in the world and that he and his associate, Mr. Howard Hughes, would have a giant aircraft, of at least 140 tons weight, ready for a test flight within 15 months.

The United States Aeronautical Chamber of Commerce in a recent report has asserted that by the end of the present year the Army Air Force Officers expect the number of Air Transport Command cargo planes to have swelled to so many thousands that air transport would approach parity with war-time ocean shipping.

Despite this acceleration and the probably eventual preponderance of air craft production, a large volume of freight must con-

Editorial Comments—continued

tinue to use sea transport, the more so as in the case of cargo, speed of transport is not generally of the highest importance. Provision will have to be made at ports as heretofore, for the reception of a considerable body of intermediate class vessels of moderate size and speed. Pure freighters will also be required in increasing numbers. So there is no occasion to take a gloomy view of the prospects of ocean navigation and port activities.

Harbours for Seaplanes.

There is another aspect of the matter of port planning which should not be lost sight of; one which, indeed, will call for increasing notice and attention. This is the provision of harbourage for marine aircraft. In several instances, suitable natural expanses of water are available without much outlay, as at Southampton and Langstone, but such surfaces will, in many cases, call for development, as they will also need multiplication. The following observations on the present situation were recently made by Mr. S. A. Dismore, a former assistant general manager of Imperial Airways.

" It is not so easy to construct aerial harbours for marine aircraft. So long as we are forced to use exposed natural waterways for marine aircraft, they will inevitably be at a disadvantage compared with their land equivalents. The science of constructing marine ' airways ' is in its infancy and is a subject which merits consideration by our civil and marine engineers. Can we improve natural waterways by scientific systems of wind brakes to minimise the risk of swell? Can swell be broken by submerged pipes emitting bubbles of air? Are systems of submergible baffles practical? Will it be best to adapt, and, if necessary, enclose areas of natural water, or will it be best to construct artificial inland water ' airway? ' These are problems on which there has been too little research."

The subject of aircraft construction and air travel hardly comes within the province of this Journal, but the problem of harbourage in sheltered waters for seaplanes has much in common with the corresponding requirement for shipping. Port authorities, therefore, may find themselves faced with the necessity of dealing with the question of the provision of such harbourage facilities within the curtilage of the port. At any rate, in view of possible post-war developments, which may be as sudden as unexpected, it would be as well for the situation to be envisaged and preliminary investigations undertaken.

A move has been made at the Port of Glasgow. Mr. William Cuthbert, chairman of the Clyde Navigation Trust, has announced his intention of proposing " that the General Purposes Committee of the Trust consider and report to the Trustees upon the subject of the provision of facilities for aircraft within the undertaking of the Trust, or upon land or waters to be acquired by the Trust, if so resolved and subject to obtaining any requisite statutory power." This would be a wise and prudent step to take, and the lead given by Glasgow in the matter will be watched with interest.

Port Labour Organisation.

In our last issue, in connection with Mr. R. T. Garrett's address, as chairman of the National Dock Labour Corporation, we discussed certain aspects of the work of the Corporation, taking occasion to point out the incongruity of the existence of three independent organisations to control a single industry. Very appropriately there appeared in the columns of our esteemed contemporary, *Lloyd's List, and Shipping Gazette* for December 23rd, an able and lucid article by a Special Correspondent on the subject of " The New Model in Dock Labour," which we have the privilege of reproducing in our current issue for the information of our readers. It sets out very clearly the functions and scope of the three bodies and a perusal will serve, we think, to confirm the observations which we have made on the subject. Obviously, it is an early obligation on the part of the two Ministries concerned to remove the existing anomaly and to bring all port labour within a single jurisdiction upon the same basic principles. It will readily be conceded that there may be difficulty in adjusting matters, due to the different rates of pay and terms of employment, but these should be capable of adjustment. At any rate, until this is done, the Port Labour Question cannot be considered as satisfactorily settled.

Harbour Salvage Operations.

The article by Engineer Salvador de Sà Noguiera on the salvage of the dredger *Alcântara*, a first instalment of which appears in this issue, is an appropriate sequel to the articles on Ship Salvage in Harbours and Docks, which appeared in our issues of August and September, 1941. The *Alcântara* represents a specially interesting case of plant salvage, since a bucket dredger with its ladder and tumbler gear is a particularly top-heavy and unwieldy type of floating craft. Moreover, in foundering, the vessel not only capsized, but completely turned turtle and embedded her upper structure deeply in the muddy silt, which formed the harbour bottom at the spot where the accident occurred. Señor de Sà Nogueira details very serviceably the steps which were taken with full success to right, suspend, lift and drain the vessel, and he and his colleagues are to be congratulated on the competency and efficiency with which the whole series of operations were carried through. The episode illustrates the risks attendant on ordinary routine operations in harbour waters.

Port Identification Marks.

The code-numbering of ships and the corresponding marking of cargo packages for shipment, which came into force at the beginning of the year, is the outcome of the recent agitation in Parliament respecting the possible disclosure to enemy spies of ship destinations. It is claimed as the result of official enquiry that no evidence has been forthcoming to prove the loss of vessels through such disclosure, but undoubtedly the possibility exists and, accordingly, any steps taken to avert or minimise the danger must meet with approval. It will be noted, however, that in accordance with the regulations issued, the name of the port of destination is still to be shown clearly and this potential danger is the subject of criticism. The writer of a letter in *Lloyd's List*, of January 7th, claiming 30 years' experience as cargo superintendent and ship's clerk, ridicules the alleged necessity of furnishing actual port names to stevedores for loading purposes, and gives detailed particulars of colour code systems in use for the purpose of overcoming language difficulties, various alphabets, erratic caligraphy and illiterate labour in foreign ports. He maintains that six colours and shapes, used in combination, give hundreds of port signs—far more than are ever required for any voyage—and contends that " numbers for ships and colours for ports " are adequate for identification, besides being " simple enough to appeal to those in authority."

In view of this reasoned and experienced testimony as to the efficiency of the number-plus-colour system of marking, it is difficult to see why the risk of actually naming the port of destination should be run. But perhaps the Ministry has grounds for its action which are not apparent to the general public.

Chinese Treaty Ports.

The system known as " Treaty Ports " in China whereby at certain ports on the Chinese seaboard, Great Britain and the United States exercised special privileges in regard to their nationals, has been abrogated by an agreement concluded between the governments of China and the other two contracting powers. The following extract from the Annex to the present Treaty explains the relinquishment of the extra territorial rights hitherto enjoyed:—

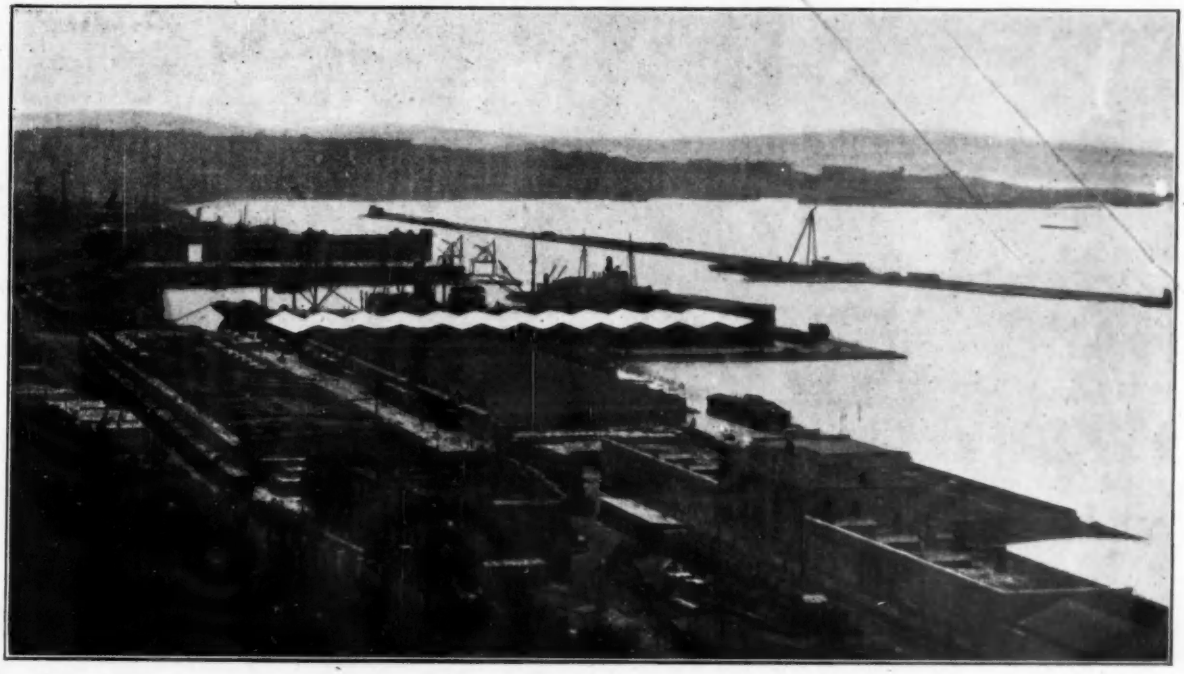
" His Majesty the King relinquishes all existing treaty rights relating to the system of treaty ports in China. His Excellency the President of the National Government of the Republic of China and his Majesty the King mutually agree that merchant vessels of one High Contracting Party shall be permitted freely to come to ports, places and waters in the territories of the other High Contracting Party which are or may be opened to overseas merchant shipping and that treatment accorded to such vessels in such ports, places and waters shall be no less favourable than that accorded to national vessels and shall be as favourable as that accorded to vessels of any third country. The term ' vessels ' of a High Contracting Party means all vessels registered under the law of any of the territories of that High Contracting Party to which the Treaty signed applies."

The full text of the Treaty will be found in a White Paper (Cond. 6417) issued by H.M. Stationery Office, price 2d.

The Future of an Adriatic Port

Prospects of Trieste

By FRANK C. BOWEN.



General View of the Porto Franco Vittorio Emanuele III.

Contending Interests

THE first sign of the inevitable break between two dictatorships is the recent German move to annex a large part of occupied Jugoslavia, threatening the very existence of Trieste. Not that the actual trade prosperity of the port is of such great importance nowadays—the other Italian ports would be glad to see the end of its competition—but it is a particularly tender spot of Italian pride, for in the years which immediately preceded the late war it was a centre of irredentist movement and the part concerned which appealed to many Italians as the most likely to be profitable.

Historical

The history of Trieste is a very long one. It was originally the Roman City of Tergeste, first mentioned about 100 B.C. as being a small place, but growing rapidly as the outlet for a large district. It had to withstand many attacks by Barbarians from the North, but its value was appreciated by the Emperor Augustus, who in 33 B.C. gave it adequate fortifications—assisted by its natural features—and built it up as a Roman colony with extensive territory. When the Roman Empire disintegrated it passed through many vicissitudes and had many masters until the Emperor Lothair made it independent under the rule of a Count-Bishop. In 1203 it was captured by Venice as a useful outpost for her trade, but the people bitterly resented it and although Trieste was nominally under Venetian rule for nearly 180 years it was in a constant state of revolt, and in 1382 it contrived to put itself under the protection of the Emperor Leopold III. of Austria, which soon developed into actual possession. After that, except for French occupations between 1797 and 1805, and from 1809 to 1813, it remained Austrian and was little influenced by the Italian and Hungarian revolutions. For this it received the name of Citta Fidelissima and in 1867 was made a separate Crown Land in the Austrian Empire.

Austrian Sovereignty

Considering the noisy Italian party which agitated for union with Italy in the early days of the Twentieth Century, it is important to remember this loyalty to Austria. The population had long been cosmopolitan. In 1900 it was reckoned that three-quarters of the people were Italian, their language being the one usually spoken, but of these many preferred to exercise their undoubted business ability under foreign rule rather than submit it to the political instability of Italy. There were also a large number of Jews, trading colonies from Germany, Britain and other countries and naturally a big Slav population.

As the natural commercial outlet for Pannonia and Dalmatia, Trieste had great possibilities for trade, which increased rapidly when the Holy Roman Empire lost the Flanders ports, but it had the disadvantage of being badly shut in by mountains. To overcome this, it was made a free port by the Emperor of Austria in 1719 and remained so until 1891, by which time conditions had changed.

During this long commercial history it built up peculiar but liberal business laws, and as the community had earned for itself a very high reputation the port prospered steadily after the end of the Napoleonic Wars. Surveys for a canal to link it with Vienna were immediately made and constantly repeated without anything definite being done for many years; in the middle of the Nineteenth Century a railway supplied the deficiency, 340 miles long, over very difficult country. The port handled the bulk of Austria's overseas trade, both inside and outside the Mediterranean, but had many rivalries on the coasting side.

Trieste undoubtedly reaped great benefit from the kindness which the Austrian Imperial House showed to the Austrian Lloyd. Starting as an insurance concern soon after the end of the Napoleonic Wars, and taking the name "Lloyd" to establish a claim to the respectability of Lloyd's of London, it branched out

The Future of an Adriatic Port —*continued*

into shipping with the encouragement of the Government in 1836 and Trieste was its base. The Government guaranteed its capital and interest and from 1851 onwards paid generous subsidies in one way or another, while the fact that the Hapsburgs were among the most important shareholders was a great advantage when it came to interpreting the regulations. Numerous services were

Electric Crane on Warehouse No. 2a.

started, not all profitable in their results, but covered by State aid and bringing a big trade into the port. Trieste also benefited indirectly by the fact that Austrian bureaucratic rule and innumerable regulations encouraged the vast smuggling trade, largely in tobacco, whose import was practically prohibited, which was centred on the port.

When Lieutenant Waghorn was establishing his Overland Route from India, the French, from political pique, raised innumerable difficulties to the mail passing through Marseilles, so he arranged one of the trial runs through Trieste, whose people were quick to see the possibilities of the business and who gave him every facility. The Trieste route beat the one *via* Marseilles by two days and the French attitude was immediately modified.

The Harbour and Port

By the middle of the Nineteenth Century the harbour, although not large, was easy of access and most convenient. It was protected from southerly winds by the Teresiano Mole, which, with the wharves, made a continuous quay a mile-and-a-half long. The quarantine dock was entirely enclosed and was a model of

Porto Franco E.F. Duca d'Aosta: Warehouse No. 72.

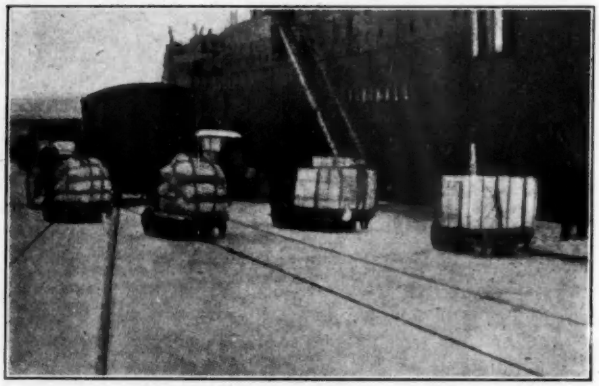
what the accommodation should be in a port which was as careful over quarantine as Trieste. It was fitted with hotels for passengers, lodgings for the crews and warehouses for goods, so that the quarantine period could be robbed of most of its discomfort and inconvenience. The only disadvantage was that the regulations were so involved and badly drafted that ships in quarantine could seldom get to the section provided for them, but were detained under most uncomfortable conditions outside.

Only ships of under 300 tons burthen could lie alongside the wharves; if bigger than that, they had to lie off on moorings and employ lighters. The harbour was exposed to the north-westerly winds, which were apt to be very violent in the winter months, although the storms were usually of short duration. Sailing ships, which formed the bulk of the port's trade, could beat into the harbour in practically any wind with very little danger. There was no compulsory pilotage, but fishermen of varying reliability were always hovering offshore to offer their services. A very large part of the import trade was trans-shipped into coasting vessels for the various Dalmatian ports. The occupation of Venezia by Italy increased the business done by Trieste immediately.

Trade Developments

From 1870 until the end of the Nineteenth Century, when most of the Continental ports were going head steadily, the trade of Trieste increased less than that of any of its rivals and as time went on, this tendency became more pronounced. The principal reasons were the poor railway communications with the heart of Austria, the decline in the Levant trade through the improvements in the Oriental railways, the diversion of trade to enterprising Italian and German ports and effective Hungarian Government support to its great rival Fiume.

At the turn of the century improvements were started, but it was an uphill fight for the next fourteen years. The Austrian and

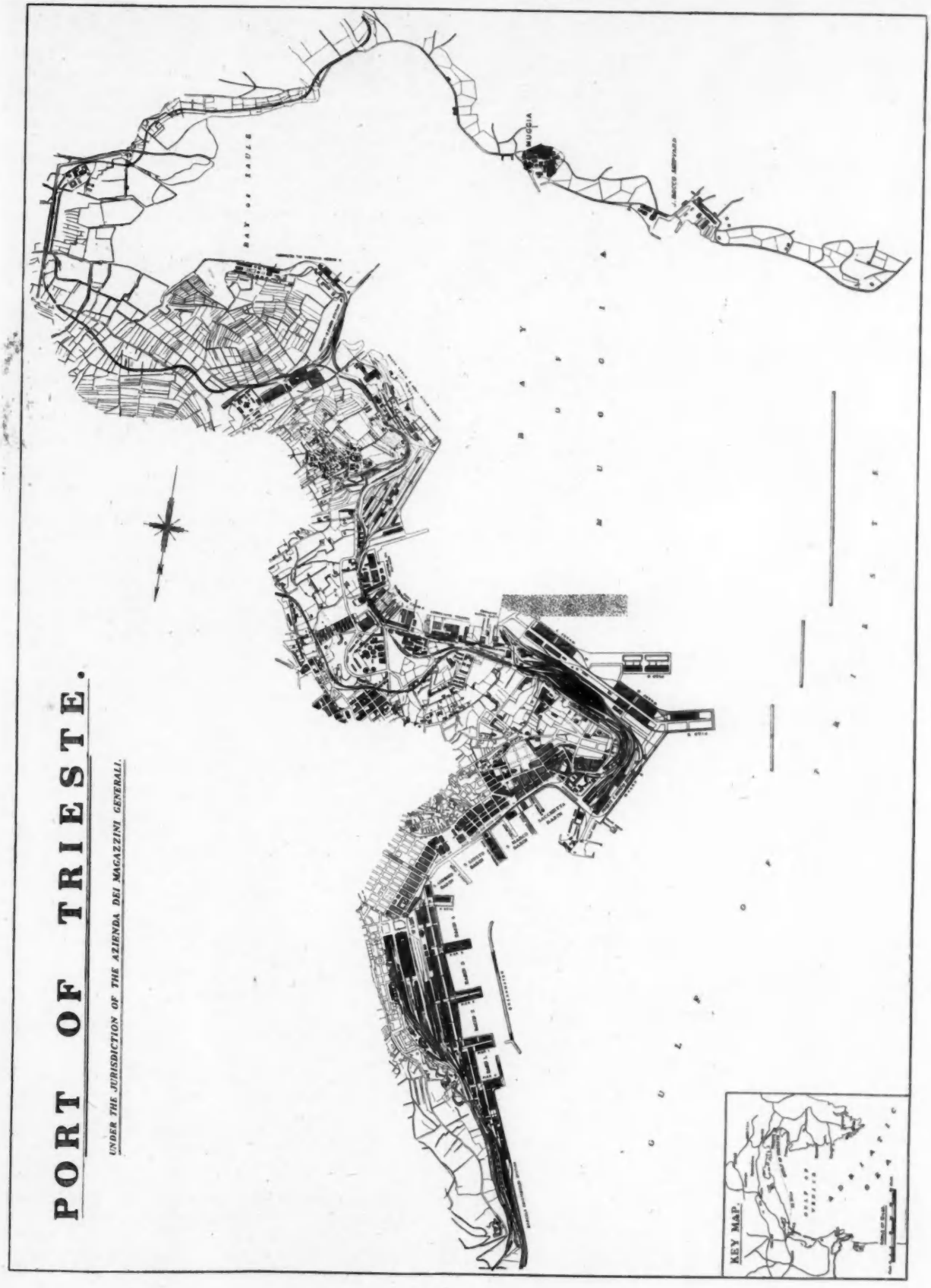


Loading Operations by means of Electric Trucks at Trieste.

Hungarian Governments could not agree to a fair distribution of the trade between Trieste and Fiume until 1912, but in 1901 the most important problem was tackled by the commencement of the railway improvements. From its commencement, when heavy grades had to be avoided, the railway took a very indirect route and a direct line to Salzburg for the German traffic had been discussed for years. Once it was started, progress was rapid, and it was completed in 1908. The New Harbour at Trieste was also commenced, demanding various alterations. The Austro-Americana Line, which had been running quite a successful cargo service to New York, decided in 1904 to compete with the Cunard Company's emigrant service from Fiume, and with the assistance of the big German Lines started an emigrant service, subsidised and otherwise helped by the Austrian Government. The Austrian Lloyd services were greatly improved with new tonnage and the Company was rewarded for its enterprise. At the same time the German State railways did all that they could to divert both cargoes and emigrants to the North Sea ports and had considerable success.

Last War Period

During the late war, the shipping of the port was practically confined to the shelter of the islands down the Eastern Adriatic Coast, but the Navy made considerable use of the privately-owned dry docks in and near the port. It was used as a base by the Austrian Navy, strongly defended by batteries and minefields with



Pre-War Plan of Trieste.

The Future of an Adriatic Port—continued

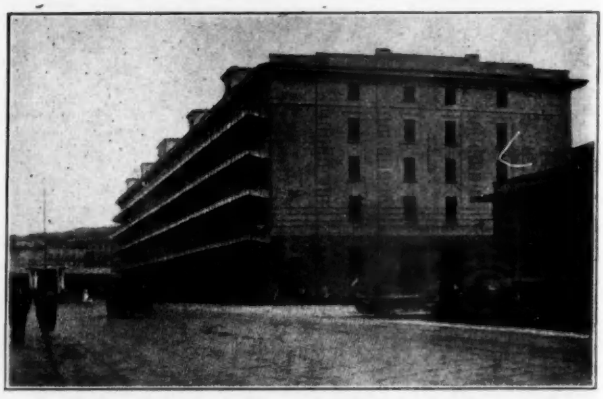
cables and nets stretched across the entrance to the harbour. During the Caporetta debacle of 1917, they had two battleships based on the port which put out daily to fire on the British and Italian Monitors covering the flank of the army, returning to Trieste each night, but the manner in which Lieutenant Rizzo, with two motor torpedo boats, sank the *Wien* close to the harbour, one of Italy's few naval deeds during the war, modified the use of the base considerably.

By the end of the war, Trieste and its immediate hinterland was greatly impoverished through the blockade and Austrian distrust of its Italian population, but for the next few years it enjoyed quite a boom revictualling Austria. Under the Treaty of St. Germain, it was ceded to Italy with very little opposition, Czechoslovakia being granted port rights, and instead of sharing German reparations tonnage with the rest of the Allies, Italy took 213 ships of nearly 600,000 tons gross, the bulk of the old Austro-Hungarian Merchant Service, which was mostly based on Trieste. The historic Austrian Lloyd, which had been largely managed by Italians for some years, became the Lloyd Triestino and other companies were similarly naturalised.

Italian Development Works

When the revictualling of Austria was completed, Trieste faced a very serious situation. Compared with 1913, entrances had decreased by 62.9 per cent., while those of Antwerp, Hamburg and Rotterdam had all increased vastly. The Italians must be given credit for tackling the problem with determination. Big harbour improvements were started, it was made an autonomous port and its management granted to a private company for twenty years, the bonded facilities were greatly improved and negotiations started with Germany to secure a reasonable division of traffic. Czechoslovakia was divided into two zones, the northern with favourable rail rates to Hamburg and the southern with favourable rail rates to Trieste. This agreement was well based but failed through Germany's bad faith. At the same time competition with Venice increased and Rome became as suspicious of the people as Vienna had been before 1914. It was not nearly so violently nationalist and pro-Fascist as might have been expected from its pre-war record; the Slav element caused strong feeling from time to time, there was great jealousy of the wealthy Greek colony and many conspicuously keen Italian supporters in the old days felt that they had been very badly treated in Rome's attitude towards the prosperity of the port.

Since the outbreak of war, when all such reports must be regarded as somewhat suspect, there have been repeated stories of rioting and anti-Fascist and anti-German outbreaks. These reports have generally been followed by columns in the Italian press affirming the complete loyalty of the port to the Duce. Its shipyards have been very busy repairing every available ship to compensate for losses in the Mediterranean, the work being carried out in face of great difficulty owing to the steel shortage, and there have recently been reports of the battleship *Conte di Cavour* and the record-breaker *Rex*, both damaged in the Mediterranean, being in the port. German plans in Jugoslavia make a big difference and reports have even been circulated that Hitler had informed Mussolini that he intended to take over both Trieste and Fiume. As far as the actual trade of Trieste is concerned it would probably increase greatly under a German rule of cold-blooded efficiency without regard to individual claims, but the prospects for the population of the area, both Italian and Slav, would be exceedingly grim.



New Warehouse No. 2a in the Porto Franco Vittorio Emanuele III.

*The New Model in Dock Labour**

(By a Special Correspondent of "Lloyd's List")

The years 1941-42 will be notable in the history of the dock industry as marking the first practical steps to decasualise the dock worker. In March, 1941, the Merseyside scheme was launched, followed a few weeks later by a similar scheme for the Clydeside; in September, 1941, the National Dock Labour Corporation, Ltd., was incorporated, and, on December 29th, commenced operations in the port of Bristol.

An Experimental Stage

The present stage of this development can only be regarded as experimental. There will be necessary changes to be made in all the schemes. It is difficult, for example, to justify, except experimentally, three separate and independent schemes for one industry, especially when labour is interchanged on such a large scale between port and port.

The Merseyside and Clydeside schemes differ from the Corporation schemes in many respects. The responsible Ministry is the Ministry of War Transport, whereas the Corporation is responsible to the Ministry of Labour. In War Transport schemes the docker is continuously in the employment of the Ministry, whether in the Reserve Pool or allocated to an employer; and the employer is a "contractor" acting on behalf of the Government. In Corporation ports the docker, when allocated to employment, is under the sole jurisdiction of his employer who is a free agent as before, and the docker only enters the Reserve Pool and so comes into the employ of the Corporation when not gainfully employed. There are three separate administrations with three separate management funds and different surcharges to the employers. Naturally the War Transport ports flourish, whereas those of the East Coast must bear a heavy charge to maintain a reserve of labour against the requirements of the West Coast.

The Two Systems Compared

The relationship of the Corporation to the Ministry of Labour makes an interesting comparison with dock labour schemes under the Ministry of War Transport. Under these latter schemes all aspects of port clearance are within the responsibility of the Regional Port Directors, including the management of dock labour. In "Corporation" ports, the dock labour scheme is one facet of dock organisation which will co-operate with but is not dependent on the Regional Port Director. In fact, whereas War Transport labour schemes are part of the Ministry of War Transport and dock workers are servants of the Crown, Corporation schemes are independent of the Ministries though working in close relationship with the Ministry of Labour. Indeed, in some ways the industry under Corporation schemes is freer from departmental control with regard to the disciplining of its labour than are most industries operating under an Essential Work Order.

*Reproduced from *Lloyd's List and Shipping Gazette.*

The New Model in Dock Labour—continued

These are differences of importance and of considerable significance.

The Ministry of Labour does define, however, the ambit of the Corporation through the Port Registration Committees, which are responsible to the Minister for defining what work is properly port transport work and, consequently, which employers and workers are subject to Corporation schemes. The Corporation is thus an interesting industrial experiment in devising a proper relationship between the Government and the industry.

The National Dock Labour Corporation, Ltd., is essentially an industrial organisation established within, and not superimposed upon, the industry. It is a public company limited by guarantee, governed by a board of directors, all but two of whom are nominated by the National Joint Council for Dock Labour and local boards, representative of both sides of the industry. The Corporation thus seeks to harness in its service the experience of those with an intimate working knowledge of the industry.

Fitting the Man to the Job

Although the decasualisation of the dockers may be claimed to be the outstanding result of the establishment of the Corporation and similar schemes, this cannot properly be described as their first aim. The Corporation, for example, it is true, pays the workers 5s. for each attendance proved when they are not working, but that is a negative aspect of the work; the positive aim is to ensure that the worker suitable for the job is available at the time and place as required. This is no easy task. The Corporation has taken over all the dockers registered in the 31 ports at which dock labour schemes now operate. The number registered is far fewer than that in peace-time, the difference being due to the considerable number of men, particularly young and virile men, now serving with H.M. Forces and in other industries. Thus the Corporation inherited a labour force not of its own selection, and one which is of a high average age and therefore more likely to be less adaptable to the sudden revolutionary swing over from casual to regularised industrial control.

Moreover, in most ports before the war, the spreadover of employment ranged very considerably, from those who had a regular following with a particular firm to those who were constantly under-employed and the outer fringe who picked up such remnants of employment as were available. Jobs were secured in all sorts of way from a tip received perhaps in a public house or at a street corner to engagement " on the stones."

Thus a first practical task of the Corporation is to build control stands and covered accommodation for the men in which to assemble for allocation by the foreman or the Corporation officer, and which will provide office accommodation for the stamping of the allocated men's attendance record books and the payment of wages weekly.

A Mobile Labour Force

In war-time it is essential that the labour force should be mobile. The Corporation has had to devise a national machine for transferring labour quickly to the ports where it is most needed.

It will be apparent to anyone with a knowledge of the industry that although, as has been said, the Corporation is an industrial concern working within the industry it is doubtful whether, except for the demands of war, such a scheme would be readily agreed. To some extent, therefore, the Corporation has been grafted on to the industry. Although the Corporation has received considerable help from workers and employers, yet the fact remains that to super-impose an embryo national scheme on an industry which is characteristically local in all other respects cannot wholly succeed unless at the same time there are some parallel adjustments on the industrial side.

The conditions of working, for example, vary considerably from port to port, and while one port may decide to meet a certain shipping demand in one way a neighbouring port will meet the same demand in another way. Similarly, although the National Dock Agreement provides certain minimum standards of pay, much of the discharging and loading is paid for at piecework rates which are determined locally. Further, the standard of mechanical equipment varies not only between ports but as between ports of a comparable size; and the traditional methods of working, some of which are based on the assumption that there is a large physical labour force available, die hard.

Variations in Guaranteed Wage

These anachronisms are thrown into high relief by the war-time transfer of men from one port to another, and most of the difficulties arising from such transfers have their origin in these facts. If to these are added the difficulties arising from the fact that a man from a Corporation port on a weekly guarantee of 55s. may be required to work in a War Transport port alongside a man with a guarantee of 82s. 6d., it will be seen that the new cloth is indeed straining the old garment.

The Turn-round of Ships

A more pertinent question is, however, what effect, if any, these schemes have had on the speedy turn-round of ships; that is the immediate justification for any such labour reorganisation in war-time. Obviously, speedy turn-round depends on so many factors, some of which are entirely beyond the control of the Corporation, that praise or blame cannot be wholly attributed to this part of port reorganisation.

If, however, the labour schemes contributed to the quicker turn-round, it will have been by having the necessary number of workers available when required, by sending the right man to the job offering and by disciplining the men who do not pull their weight. But even the most enthusiastic supporters of decasualisation would not agree agree that all is well. When large numbers of men are sent from one port to another to fill innumerable jobs there are bound to be some misfits. Yet the outstanding fact is that there has been no serious hold-up of loading or discharge through shortage of labour and that demands for transferred labour have been filled 99 per cent.

This is not the whole picture. There have been labour difficulties, some stoppages of work, and there is some absenteeism. But against the worst figure of absenteeism for any port should also be placed the fact that in a large West Coast port absenteeism, i.e., absence without reasonable explanation, is generally less than 1 per cent. of the labour force. Similarly, while there have been cases of " go slow " methods, these must be put alongside many record outputs.

All that can, therefore, be said is that a well-managed labour force is more likely to give better output consistently, and that although the weekly, as against a daily, payment of wages is desirable and a necessary reform, this mechanical change, from the point of view of output, is valueless without good management. The labour schemes therefore will stand or fall by the quality of their management. On this question there can be no final opinion at the moment; all that can be said is that in some ports there is good management and that the output of these ports has been good. Unfortunately this issue, which is basically a managerial problem, has been clouded too often with emotional exhortations of vitriolic denunciations which only hinder workers and management alike in their efforts to grapple with their urgent, important and gigantic job.

The dock labour schemes represent a first attempt to rationalise the labour force of this ancient, picturesque and highly individualised industry. Employers and workers have shown an increasing willingness to co-operate in making the schemes work; the strain and urgency of war needs demand some such scheme to ensure the proper use of available man-power. There is every reason to believe that this joint management of labour by employer and worker will be able to solve the many problems of dock labour both in war and peace.

Mersey Docks and Harbour Board.

At a meeting of the Mersey Docks and Harbour Board on December 23rd, Sir Thomas A. L. Brocklebank, Bart., and Mr. Edmund Gardner were re-elected chairman and deputy-chairman, respectively. No changes were introduced into the composition of the standing committees, which were elected *en bloc*.

Notes of the Month

Death of Scottish Harbour Official.

The death has been announced of Mr. George Dunlop, treasurer of the Greenock Harbour Trust.

United States Port Appointment.

Mr. Harvey C. Bisckel, acting port director at Milwaukee, Wis., has been appointed port director. He was formerly secretary to the port commission.

Improvement Works at Tasmanian Port.

It is announced that harbour improvement works which have been in progress at Devonport, Tasmania, during the past six years are at the point of completion.

Reconstruction of French Harbour.

The harbour at St. Denis on the Ile d'Oleron off the French Coast of Rochefort, having become useless through accumulations of silt and sand, plans have been prepared for the construction of a new harbour.

Port of Barranquilla Administration.

It is reported that the Columbian Government has now taken over the full control and administration of the Port of Barranquilla, for which the contractors are to receive over a period the balance still owing on account of works executed, estimated at 1½ million U.S. dollars.

Port of Bombay Finances.

At a meeting of the Trustees of the Port of Bombay at the end of August last (report of which has just come to hand) the audited accounts for the year ended 31st March, 1942, were approved for submission to the Government of India. The revenue surplus on General Account amounting to 91.79 lakhs is to be transferred to the Revenue Reserve Fund, which will now stand at 198.08 lakhs.

Port and Navigation Authority Honours.

The dignity of knighthood has been conferred on Mr. Frank Nicholson, chairman of the River Wear Commission. Lieut.-Col. Frank Rayner, managing director of the Trent Navigation Company and Mr. Michael J. Watkins, general manager and secretary of the Belfast Harbour Commissioners, have been awarded the C.B.E.

Labour Zoning Scheme on Merseyside.

The North West Regional Port Director (Mr. Robert Letch) has inaugurated a zoning system for stevedoring and master porterage firms in respect of ocean vessels arriving at the Port of Liverpool, including Birkenhead. It is understood that the scheme entails the division of the docks into five zones, four at Liverpool and the fifth at Birkenhead, each with its own controller. It is a similar arrangement to that in vogue at Glasgow which was also introduced by Mr. Letch and is said to work satisfactorily.

Scottish Cargo Handling Records.

In a New Year message to Clydeside dockers, Mr. Tom Macpherson, the recently appointed Scottish Regional Port Director, said that a record had been established for the port by the discharge of a cargo of 2,275 tons in one day, while another remarkable achievement was the discharge of a general cargo of 9,136 tons in 5½ days. He added that it was now generally appreciated that dockers were skilled workers and that in war, as in peace, they had a vital part to play in the life of the country. The regular employment and better wages now being earned were reflected in the increased tonnage handled—a very important point at this stage of the war. By operating piecework to a still greater extent, dockers would be making an additional effort and a contribution to the war effort. Piecework had greatly improved discharging operations.

Seaham Dock Appointment.

Mr. Henry Austin Samuel has been appointed mechanical engineer to the Seaham Dock Company in succession to the late Mr. J. F. Black.

South American Harbour Damaged by Earthquake.

It has been anuounced by Vichy radio that an earthquake in Columbia has done considerable damage to the harvour of Lovica and the town of Chima. Lovica is a port on the Gulf of Darien.

Distinctions for Dry Dock Managers.

Among the recipients of the M.B.E. included in the New Year Honours List are Messrs. Alexander Harvey, general manager of the London Graving Docks Co., Ltd., and Arthur John Maplestone, manager of the Mountstuart Dry Docks, Ltd., Cardiff.

Retirement of Tyneside Dock Official.

After 32 years' service as head foreman shipwright and dockmaster with the Mercantile Dry Dock Company, Mr. Robert H. Matthews, who holds the record of having docked 3,040 ships without mishap, has retired. His popularity and faithful service were recognised by presentations from the board of directors and his fellow workmen.

Barcelona Port Trade.

According to San Sebastian Radio the total number of vessels entering the harbour of Barcelona during 1942 was 2,200, with a tonnage of 1,300,000. The port did a greater traffic in merchandise than in any previous war year. Over 600,000 bales of cotton were received from Brazil, Egypt and the Congo, 80,000 tons of wheat from Argentina and 450,000 tons of coal (country of origin not stated).

Liverpool Port Emergency Committee.

At the instance of the Liverpool Chamber of Commerce, the Liverpool Port Emergency Committee have agreed to the nomination by the Chamber of a representative of private warehouse owners to serve on a warehouse and storage sub-committee set up to compile particulars of storage and warehouse accommodation in the port area. The Chamber has nominated Mr. J. H. Brooks and has invited the submission of representations on any matters for consideration.

Code Regulation for Overseas Cargoes.

All ocean-going merchant vessels which began loading in this country on and after January 1st have been allotted a code number by the Ministry of War Transport. This code number is to be stencilled in distinctive colours on the individual packages together with the name of the dock at which the ship is loading. The port of destination is still to be shown clearly. The name of the ship is not to be shown. Railway consignment notes are to be made out as now, except that the code designation of the vessel must be shown instead of the name which must not be given. The railway wagon ticket and the railway invoice are also to bear the code designation of the ship.

Distinctions for P.L.A. Officials.

Included in the New Year Honours List are awards of the M.B.E. to two members of the staff of the Port of London Authority: Mr. A. Kilby and Captain L. J. Lovell. The former has had a long connection with the timber trade, particularly at the Surrey Commercial Docks. He was in the service of the Surrey Commercial Docks Company prior to its absorption in the Port Authority. Mr. Kilby had reached the official age of retirement. but has been retained in the service on account of his great experience and by reason of the war. Captain Lovell was for some time master of a steam hopper engaged on dredging operations in the Yantlet Channel; then he was transferred to the harbour service and became an assistant harbour master, a position which he still occupies.

*The Salvage of the Dredger "Alcantara"**

A Portuguese Harbour Problem and its Solution

By Engineer SALVADOR DE SA NOGUEIRA,
Inspector of Salvage in the Tagus, Secretary to the Board of Naval Administration.

Preliminary Particulars

AS a result of a severe gale that unleashed its fury on the harbour of Lisbon, about midnight on December 31st, 1939-January 1st, 1940, the dredger in question lost its transverse equilibrium which maintained it in an upright position, gradually converting its keel into a luff-ladder, as the sailors' parlance renders it, or, more simply, capsized with its bottom upwards.

The site of the disaster was close to the new mole of the third section of the harbour works, at a spot in the neighbourhood of the Santa Apolónia entrepôt.

There the dredger had been engaged in clearing the accumulations of silt close to the quay.

In this its new upturned position, with about 3-4 metres of its turret submerged in the mud, of which the bottom stratum there consists, the dredger still retained a sufficient reserve of buoyancy due to the air that continued to circulate in its compartments.

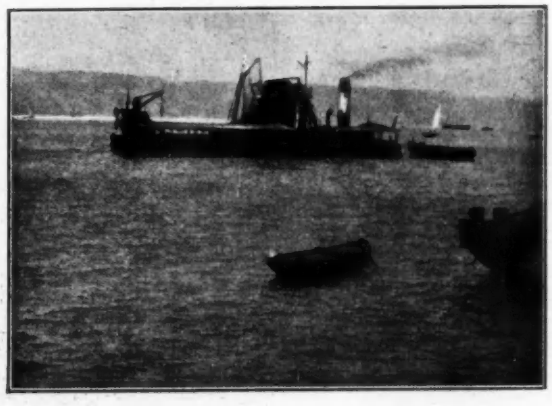


Fig. 1. Bucket Dredger "Alcantara" of the A.G.P.L. (Port of Lisbon Authority).

With the ebb and flow of the tides, the currents of inflow and recession and the disturbance in the water itself, this buoyancy was reduced to a mere residue and in the course of a few days, the vessel developed a tendency to heel over so as to settle down, with the full length of its starboard side embedded in the mud.

The turret, part of the ladder and buckets, gearing, funnel, in brief, the entire deck of the starboard side, etc., were buried in the mud. (Figs. 3, 4, 5 and 6).

The dredger, on heeling over, collided violently with its turret against the quay to which it was adjacent, at the re-entrant part between the two service stairways located there, dislocating and scarring the masonry of the quay surface and the steps of the stairways.

As a result of the capsizal, there dropped into the sea all the parts and equipment that were lying unsecured on the deck. A crane mounted upon the deck became detached from its accessory pivot and also fell into the sea.

In this way the space comprised between the mole and the vessel became congested with all manner of articles, thus creating a serious impediment in the carrying out of the diving operations which were really seriously obstructed by the haphazard accumulations, consisting of plumb lines, iron rods, zinc plates and the like.

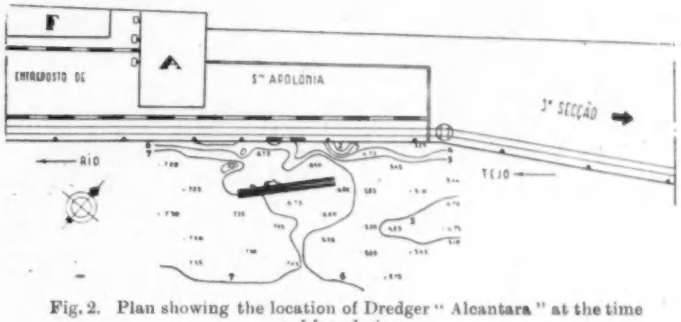


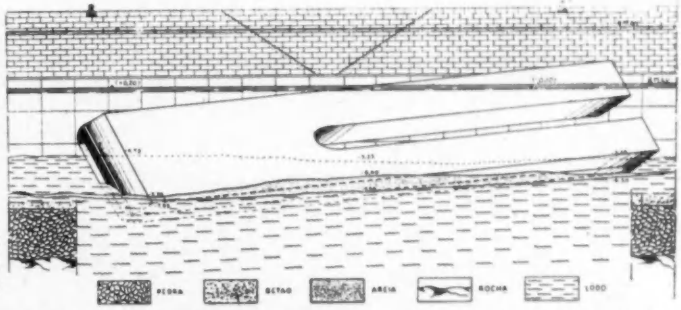
Fig. 2. Plan showing the location of Dredger "Alcantara" at the time of foundering.

These difficulties were further accentuated by the narrowness of the clear space available, the opacity of the water, the strong inflow and recession currents and the practically continuous bad weather that prevailed from the time of the capsizing of the dredger until it entered the dry dock.

I should remark in passing that the capsizing of dredgers is an occurrence very frequently happening in unfavourable waters to which this type of vessel seems specially liable.

The literature on the subject will furnish a thousand examples.

The reason for this is to be found in the defective transverse stability of the vessel, when the ladder is withdrawn within its housing. The turret, the gearing and the entire ladder itself raise the centre of gravity without appreciable risk so long as there are no external overturning influences, but the danger is great when anything happens to cause an inclination of even a few degrees. Listing then becomes fatal owing to the destruction of any reserve of transverse stability and of buoyancy as is illustrated in Fig. 7.



Pedra=stone Betão=concrete Areio=sand Rocha=rock
Lòdo=mud

Fig. 3. View of the position of the Dredger "Alcantara" before it was righted on February 10, 1940.

The resultant moment of transverse stability

$$m = P\ (r\text{-}a)\ \mathrm{Sin}\ \alpha$$

serves to show how slender is the stability of these vessels.

The freeboard of vessels of this class is simply a few centimetres, which explains why water can so easily overflow them.

It has been pointed out to me that in Macau, a dredger was also capsized as a result of a hurricane. Several of the crew, who

*Translated from the Portuguese official account in a Report submitted to a Meeting of Engineers on May 29th, 1940. The preparation of the drawings and photographs for this article was supervised by Engineer Leo Muginstein.

Salvage of the Dredger "Alcantara"—continued

were subsequently rescued had been unable at first to reach the outside and remained imprisoned within. Yielding to the general impression that they were victims of the disaster, they maintained themselves stowed away in the bottom of the dredger whither they had arrived from the vessel's interior. It was immediately resolved to cut an outlet at the spot where these stowaways were

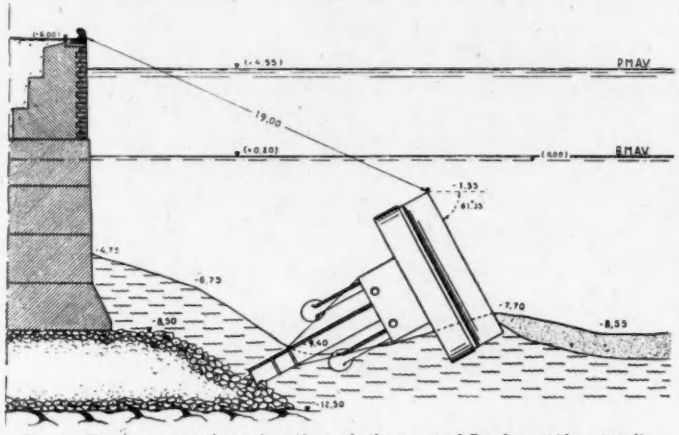


Fig. 4. Transverse section taken through the prow of Dredger "Alcantara" prior to its righting on February 10, 1940.

congregated, and thus provide a means of escape for the unfortunates who were thus saved, as by a miracle, from inevitable death. The incident thus escaped becoming a tragedy.

This reserve of air enabling the vessel to float bottom upwards for a certain time was the means of saving the lives of the otherwise unfortunate crew, or for a time sufficient for their comrades ashore to go to their rescue.

What a heart-rending situation for the crew in question!

What is obvious is that the sub-division of the dredger into water-tight compartments exercised a favourable influence on the breaking-in operations, an effect especially beneficial for the derelicts shut up within.

At Hong Kong, in November, 1900, the dredger *Canton River* turned turtle in consequence of a hurricane and submerged itself to a distance of 120 metres from the quay.

Various attempts, all of them futile, were undertaken to right the vessel until, finally, Sir Percy Scott, the celebrated admiral,

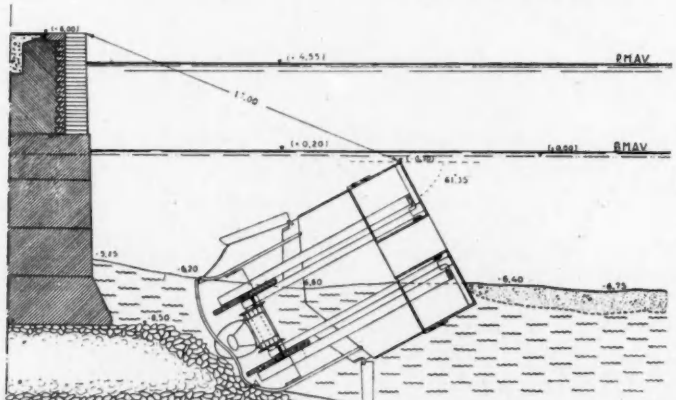


Fig. 5. Cross-section taken on a line near the central section of Dredger "Alcantara" before it was righted on February 10, 1940.

reached the port aboard the *Terrible*, the ship he then commanded, and at once assumed the direction of the operations.

In the case of the *Canton River*, the turret projected outwards at the side, differing in this respect from the dredger *Alcântara* which had its turret turned upside down against the wall of the mole.

The solution adopted for the righting of the *Canton River* was that of gripping the hull in its entirety by means of four tow-cables consisting of stout chains, with one of two flying cables rigidly secured to a suitable point of the deck and the other secured to a substantial pulley over which ran a length of steel cable fixed securely on land by one of the cables and with the further rein-

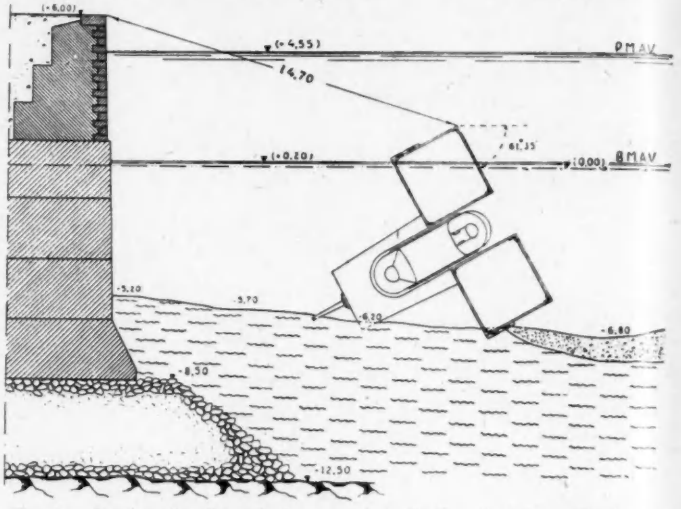


Fig. 6. Cross-section through the poop of the Dredger "Alcantara" prior to its righting on February 10, 1940.

forcement of an anchor embedded in the ground and operated by a steam winch mounted also on terra firma on the quay.

The raising on the side of the turret was effected with the aid of a tank filled with water at low tide and then evacuated by means of pumps at full tide. The torpedo-destroyer *Hardy* provided compressed air for the interior of the dredger in order to lighten the latter to some extent and to facilitate the operation of righting.

As a result of the expedients adopted and by the employment of a liberal number of workmen, the righting aimed at was achieved on the 18th January, or after the lapse of about two months from the date of capsizing.

In this way the first problem was solved; there remained the second, i.e., that of raising the vessel. To accomplish the latter,

L & L' = Buoyancy lines
α = angle between them
C & C' = corresponding keel centres
G = centre of gravity
M = initial transverse metacentre
P = weight of dredger
I = motive force
r = transverse metacentric radins
r — a = transverse metacentric elevation

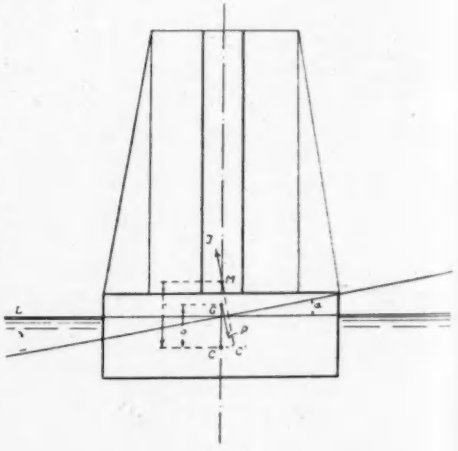
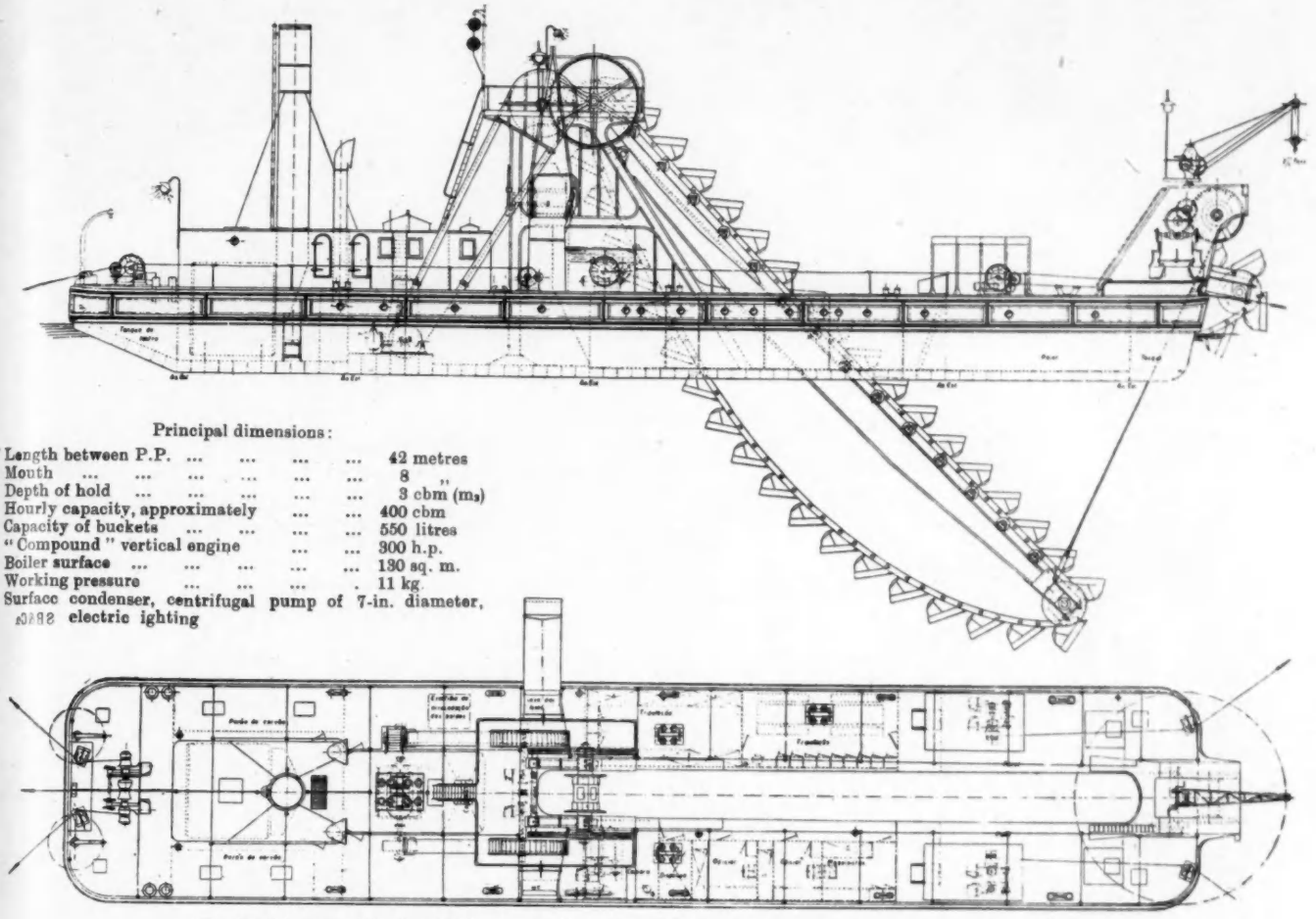


Fig. 7

the damage sustained in the first operation had to be made good and after inspection by divers and closing up the leaks and other apertures, "cofferdams" were constructed round the hatchways. The water above the deck at the period of full tide reached a depth of about 3 metres.

Salvage of the Dredger "Alcantara"—continued



Principal dimensions:

Length between P.P.	42 metres
Mouth	8 ,,
Depth of hold	3 cbm (m_3)
Hourly capacity, approximately	400 cbm
Capacity of buckets	550 litres
"Compound" vertical engine	300 h.p.
Boiler surface	130 sq. m.
Working pressure	11 kg.
Surface condenser, centrifugal pump of 7-in. diameter, electric ighting	

Fig. 8. Diagram of Dredger "Alcantara" of the Port of Lisbon Authority (in elevation above and plan below).

With the assistance of the pumps, the draining-out was started on the 1st day of March, and the vessel was caused to float. It was being transported on its reduced flotation when on the 2nd, as the draining was being proceeded with and the vessel was floating in this way, the water began to penetrate through a hole on the larboard side and with such profusion that the pumps were unable to expel it, the result being that the dredger again turned turtle and was submerged anew.

After it had been got right for the second time by the same process, we got it suspended on July 27th and transported to the dry dock. Thus, eight months had proved necessary to accomplish this.

This instance may serve to illustrate the nature of the difficulties besetting operations of this class, and it is cited here so as to impress my hearers and readers with the caution of not rashly condemning to death the man who, after devoting his scientific skill, knowledge and labour, with concentration, self-denial and even sacrifice of his property, to the task of salvaging a vessel, fails somehow in realising his purpose. Let me remind you of the deep chagrin which I know he is conscious of in having failed to achieve his aim and, let me repeat, he is worthy of our sympathy.

The average layman fails utterly to estimate even vaguely the pre-occupations and solicitudes attendant on the life of the man who is saddled with the responsibility of undertakings of this category in which one's name and, perhaps, something more substantial, are at stake.

The fact remains, however, that satisfactory results from the outlays incurred will normally suffice to compensate the salvager for the time and labour involved.

MECHANICAL ANALOGY

Laws of Newton and Froude

In the course of carrying out the work of salvaging the dredger *Alcântara*, I have, as I instanced already in the case of the tug-boat *Cabo Sardão*, had occasion to avail myself of the familiar theorem which Sir Isaac Newton enunciated in 1740, and which serves to determine the conditions in which two geometrically similar material systems can be subjected to similar dynamical treatment.

Based on this law of his immortal compatriot, the celebrated naval engineer and constructor, William Froude, enunciated, in 1870, the remarkable law of analogy which bears his name, and to which is due all the progress and improvements made, during the last 50 years, in the keels of vessels and in augmenting their powers of resistance when being impelled through the liquid medium. This law, which is one of great scope and applicability, finds its utilisation in the problem of motion through any fluid and to it may be credited much of the progress made in aviation, in artillery and in hydraulics. It may be applied with excellent results also to the radiation of heat and to the study of the resistance of materials.

It does not appear to me inopportune, therefore, to make here a few cursory references to the two laws of the English scientists, and if my doing so should prove tedious to my hearers or readers, I hope they will excuse me.

Let us consider a system of points subject to any constraints whatsoever, and a second system similar to the former as regards both position and constraints.

Salvage of the Dredger "Alcantara"—continued

Thus let G_1 and G_2 denote corresponding magnitudes of two systems L_1, M_1, T_1 and L_2, M_2 and T_2 respectively, magnitudes representing the homologous linear dimensions, the mass and the time in the two systems; K, α, β and γ arbitrary numerical factors, λ, μ and τ arbitrary relations governing variations in these fundamental units;

$$\lambda = \frac{L_2}{L_1},\ \mu = \frac{M_2}{M_1} \text{ and } \tau = \frac{T_2}{T_1}$$

The two equations of dimension may be given the form:

$$G_1 = K\, L_1^{\alpha}\, M_1^{\beta}\, T_1^{\gamma} \qquad G_2 = K\, L_2^{\alpha}\, M_2^{\beta}\, T_2^{\gamma}$$

But

$$G_2 = K\,(\lambda L_1)^{\alpha}\,(\mu M_1)^{\beta}\,(\tau T_1)^{\gamma}$$

and accordingly,

$$\frac{G_2}{G_1} = \lambda^{\alpha}\ \mu^{\beta}\ \tau^{\gamma}$$

which is the expression of the relation of the similarity between the two systems.

To the arbitrary relationships thus formulated we now add the two following: $\phi = \frac{F_2}{F_1}$ and $\nu = \frac{W_2}{W_1}$ where

F_1 and W_1, F_2 and W_2 represent the values of the force and velocity in the two systems respectively.

If we denote by m_1 the mass of a point of the first system and by X_1, Y_1 and Z_1 the forces urging it to move parallel to the three axes of rectangular co-ordinates, and by m_2, X_2, Y_2 and Z_2 the similar magnitudes in a second system similar to the first and similarly situated relatively to the origin, a stipulation in no way infringing the generality, the motions of the two systems are then appropriately expressed by the equations:

$$\Sigma\left[\left(m_1\frac{d^2x}{dt^2} - X_1\right)\delta x + \left(m_1\frac{d^2y}{dt^2} - Y_1\right)\delta y + \left(m_1\frac{d^2z}{dt^2} - Z_1\right)\delta z\right] = 0$$

$$\Sigma\left[\left(m_2\frac{d^2x}{dt^2} - X_2\right)\delta x + \left(m_2\frac{d^2y}{dt^2} - Y_2\right)\delta y + \left(m_2\frac{d^2z}{dt^2} - Z_2\right)\delta z\right] = 0$$

extended to all points of the two systems.

The second of these equations may be replaced by:

$$\Sigma\left[\left(\mu m_1\frac{\lambda\, d^2x}{dt^2} - \phi X_1\right)\lambda\,\delta x + \left(\mu\, m_1\frac{\lambda\, d^2y}{dt^2} - \phi Y_1\right)\lambda\delta y + \left(\mu m_1\frac{\lambda d^2y}{dt^2} - Z\right)\lambda\,\delta z\right] = 0$$

$$\Sigma\left[\left(\frac{\lambda\mu}{\phi}m_1\frac{d^2x}{dt^2} - X_1\right)\delta x + \left(\frac{\lambda\mu}{\phi}\,m_1\frac{d^2y}{dt_2} - Y_1\right)\delta y + \left(\frac{\lambda\,\mu}{\phi}\,m_1\frac{d^2z}{dt^2} - Z_1\right)\delta z\right] = 0$$

This last equation becomes transformed into the first if we replace dt by $\sqrt{\frac{\lambda\,\mu}{\phi}}\,dt$, or, in other words, if the relation of the times is:

$$\tau = \sqrt{\frac{\lambda\,\mu}{\phi}}$$

This expression for the relationship between the times may be arrived at otherwise:

$$\phi = \frac{F_2}{F_1} = \frac{M_2\, L_2\, T_2^{-2}}{M_1\, L_1\, T_1^{-2}} = \frac{\lambda L_1\,\mu\, M_1^{-2}\, T_1^{-2}}{L_1\, M_1\, T_1^{-2}} = \lambda\mu\tau^{-2}$$

or

$$\tau = \sqrt{\frac{\lambda\,\mu}{\phi}}$$

By the same method we obtain

$$\nu = \frac{W_2}{W_1} = \frac{L_2\, T_2^{-1}}{L_1\, T_1^{-1}} = \lambda\,\tau^{-1}$$

or

$$\nu = \frac{\lambda}{\tau}$$

or again

$$\nu = \sqrt{\frac{\lambda\,\phi}{\mu}}$$

Consequently, the motions of two systems of material points that are similar in respect of the positions and constraints of each, remain similar when the homologous points describe similar curves in times that are proportionate, and more specifically when $\tau = \sqrt{\frac{\lambda\,\mu}{\phi}}$ and $\nu = \sqrt{\frac{\lambda\,\phi}{\mu}}$ where λ, μ, ϕ, τ and ν denote respectively the relationships subsisting between the homologous linear dimensions, the homologous masses, and the similar forces similarly directed and acting as homologous points, as also between the times and the velocities.

It is this fundamental theorem enunciated by Newton two centuries ago which yields most fertile results when applied in practice. It is fitting that we should cite it in this year when we celebrate the centenary of our independence and of the restoration of our liberty after 60 years of oppression.

A condition for comparing the two systems is:

$$L_1\, T_1^{-2} = L_2\, T_2^{-2} = \lambda\, L_1\, \tau^{-2}\, T_1^{-2}$$

an equation which is satisfied when

$$\lambda\,\tau^{-2} = 1$$

that is to say, when

$$\tau = \sqrt{\lambda}$$

These results, however, for ν the same value

$$\nu = \sqrt{\lambda}$$

and then, of necessity, $\mu = \phi$

In other words, the motions of the two systems will be similar, that is, the homologous points will describe curves that are similar in proportionate periods. The relationships between the periods and the velocities are as expressed above. Such are the conditions under which the two systems envisaged and geometrically similar, will be subservient to similar treatment dynamically.

Let us now consider the application of the foregoing to the motion of two ships assumed to be geometrically similar.

We revert to the expression: $\nu = \sqrt{\frac{\lambda\,\phi}{\mu}}$

The relationship between the masses μ will be equal to λ^3 from the instant when the immersed parts of the two vessels, as also the differences in the immersed parts, maintain the relationship $\phi = \lambda^2$ of similarly linearly.

From this it follows that the resistance met with by two geometrically similar vessels will be of the form $\phi = \lambda^3$, if the relationship between the velocities is $\nu = \sqrt{\lambda}$.

This is the principle of Froude which may be enunciated as follows:

When the velocities of two geometrically similar vessels are proportionate to the square roots of their homologous dimensions ($\nu = \sqrt{\lambda}$) then their resistances will be in proportion to the cubes of the same dimensions

Velocities which satisfy the condition $\nu = \sqrt{\lambda}$ are designated corresponding velocities.

This allows us to enquire how the law of similar dynamics can be applied to the case of the motion of two vessels of perfectly frictionless keels through an ideally perfect fluid.

Salvage of the Dredger "Alcantara"—continued

Expedients due to the same Froude allow of the law being applied to ordinary cases. When λ is very small, the law may be applied with sufficient rigour, irrespective of the degree of roughness of the keel surfaces.

Resuming: Let us consider a vessel of definite dimensions and impelled velocities V_1, V_2, V_3 and a standard vessel geometrically similar to the former, as regards linear relationship λ and impelled by corresponding velocities

$$v_1 = \frac{V_1}{\sqrt{\lambda}}, \quad v_2 = \frac{V_2}{\sqrt{\lambda}}, \quad v_3 = \frac{V_3}{\sqrt{\lambda}} \ldots .$$

then if the resistances of the vessel and the standard one are designated respectively, R_1, R_2, R_3 and r_1, r_2, r_3 we shall have:

$$R_1 = r_1 \lambda^3; \quad R_2 = r_2 \lambda^3; \quad R_3 = r_3 \lambda^3;$$

In the application of such expedients to the dredger *Alcântara*, it is, of course, obvious that it is impossible to proceed with the rigour possible when dealing with experimental tanks or when investigating the resistance of perfectly frictionless keels.

The tests carried out with the standard vessel possessing the linear similarity relationship with the dredger of $\lambda \times 48$, a relationship adopted in the construction of similar vessels extant and equipped with six driving cylinders and employed in salvaging the tug *Cabo Sardão*, for which operation a similar standard vessel was constructed having the said relationship with the tug, were intended primarily to verify the value of the solutions devised for the problems involved.

(To be continued)

Proposed Dry Dock and Shipyard at Vera Cruz.

The President of the Republic of Mexico has authorised construction by the Federal Government of a dry dock and shipyard at a site on the Island of San Juan de Ulna in the harbour of Vera Cruz. The estimated cost of the undertaking is $5,150,000.

South African Harbour Finances.

The general manager of the Union Government's Railways and Harbours for the year ended March 31st, 1942, shows an accumulated surplus totalling £6,872,926, as compared with £3,231,419 a year earlier. This remarkable result was achieved in the face of many difficulties, which were accentuated by the steady flow of experienced personnel to the Forces, no fewer than 10,065 railwaymen being on full-time military service at the end of August, 1942.

Good traffic transported totalled 34,058,515 tons, exceeding by no less than 939,203 tons the previous record figure established in 1940-41. Passenger revenue at £8,499,227 exceeded the previous record figure established in 1940-41 by as much as £1,500,385.

North East Ports and Coal Shipments.

Writing on the coal shipments from the North East Coast, a correspondent of *Lloyd's List* states that for 1942 these were below those for 1941, but he expresses the view that there are prospects that shipments for this year will equal, if not eclipse, those for last year. He adds: Decreased shipments have left their mark on accounts for 1941 for local harbour and dock authorities. The indication is that even with austerity pruning in estimates for last year, especially on capital expenditure, these undertakings will consider themselves fortunate, as one chairman put it recently, to complete their accounts with a small loss. They normally depend for something like 80 per cent. of their income on dues and charges derived from the coal trade. Not only has this trade fallen substantially compared with, say, 1938, but revenue from other trades, in general merchandise and timber, has also fallen. There have been increases in dues since the war, at some ports of 100 per cent., but, as accounts will show, these increases have not made complete compensation.

On the expenditure side, there have been fairly heavy advances in operating costs, especially in wages. There has also been considerable expenditure of a capital nature in the way of war-time provisions for A.R.P. and other matters, although such expenditure has been subject to substantial Government grant. Any prospective increase in coal shipments is to be welcomed, especially by harbour undertakings.

Notable Port Personalities

XXXI—Col. J. G. Brydon Beazley

Colonel James Geoffrey Brydon Beazley, M.C., T.D., D.L., J.P., Chairman of the Executive Committee of the Dock and Harbour Authorities' Association and a member of the Mersey Docks and Harbour Board since 1928, was born at Birkenhead in September, 1884. He was educated at Marlborough College, and at Oriel College, Oxford University, where he graduated and took the M.A. degree.

Col. J. G. Brydon Beazley.

Entering his father's business of shipbrokers, Messrs. Gracie Beazley and Co., he eventually became senior partner.

He was chairman of the Liverpool Steamship Owners' Association in 1933 and 1934, and President of the Liverpool Shipbrokers' Benevolent Society in 1934 and 1935. He has been Honorary President of the Royal Liverpool Seamen's Orphan Institution since 1924.

Colonel Beazley did military service with the Volunteers and Territorial Army from 1906 to 1927. He held a staff appointment from 1914 to 1919; was awarded the Military Cross in 1918 and the T.D. in 1919. He commanded the 7th Battalion The King's Regiment (Liverpool) T.A., from 1923 to 1927 and was promoted Brevet Colonel in 1927.

Colonel Beazley is a Deputy Lieutenant and J.P. for the County Palatine of Chester.

Dock Labour Scheme for Cornish Ports.

The Essential Work (Dock Labour) Order, 1941, has now been applied to the Cornish ports, Fowey, Par, Charlestown, Truro, Falmouth, Penryn, Porthleven, Penzance, Newlyn, Mousehole, St. Ives, Hayle, and Portreath. The scheme, which became operative on January 11th, follows the schemes in operation at other ports in Great Britain where the Essential Work Order has been applied, allowances being made to meet the requirements of local conditions. The constitution of the County of Cornwall Dock Labour Board is as follows: Mr. S. F. Hough (chairman), Messrs. G. H. Bennets, W. E. Cavill C. R. Harvey, J. Hill, R. Jose, B. C. Opie and J. J. Richards. The area manager is Mr. M. J. Kenna and the area office is at Falmouth.

Sea-going Hydraulic Hopper Dredgers*

History of their Design, Development and Operation

By Lieut.-Col. H. B. VAUGHAN, Jr., Corps of Engineers, U.S. Army.

(Concluded from page 211)

Model Tests

The following figures will give some idea why so much study is given to the appendages on a vessel of this type, since the total loss in speed amounts to 2 knots or 15 per cent. over the bare hull:

	knots
Hull, without appendages, with hopper openings, loaded to 16,600 long tons	15.8
Same as above, with twin rudders and shaft bossing added	15.2
Same as above, with rudders, bossing and drag pipe added	14.3
Same as above, with rudders, bossing, drag pipe and sponson added	13.4
Effective horse-power	4480
Shaft horse-power	7000
Revolutions per minute	112

Much thought was given the feasibility of closing off the hopper openings in the bottom of the vessel to reduce resistance at full speed. Various means of closing these openings by use of auxiliary doors were tried, using a linkage between the two doors to enable both to open and close at the same time. Some concern was felt over the likelihood of damage to the outer door, flush with the shell, and the jamming or lack of effectiveness that might ensue. However, when the model was run with and without hopper openings, it was found that the resistance due to these openings was less than 3 per cent. of the total resistance at full speed. Hence it was decided that the saving in power due to closing of the openings would not justify the risk and mechanical difficulty involved.

Draft

When fully loaded, the draft forward is 24-ft. 10-in. and aft, 26-ft. 2-in. In light condition (that is with a displacement of 8,200 tons) the forward draft is 9-ft. 1½-in., and aft, 21-ft. 2½-in. Due to the trim the tip of the propellers in light draft will be 4-ft. 6-in. below water. When in light condition, a speed of 16.5 knots can be obtained.

It is estimated that the hull steel will amount to about 4,775 tons; wood and outfit 1,498 tons; machinery (wet), 995 tons, making a total of 7,268 tons. The 7,400 tons used in the calculations allow a margin of only 132 tons for all contingencies. This margin may appear very liberal to some, but considering the large amount of machinery required for a vessel of this type, and the severe hull loading a liberal safety factor must be used in estimating the weight.

Appendages

The twin rudders are of a modified spade type, semi-balanced and about 17-ft. deep. The area of the two rudders combined is over 2.25 per cent. of the product of the length and draft of the vessel. Correcting for cutaways forward and aft, this percentage increases to nearly 2.5 per cent. of the lateral plane of the vessel.

Appendages which cause a great deal of resistance on a vessel of this type, and which are not found elsewhere, are the dredging suction pipes, or drag pipes, and their sponsons. These drag pipes must be led through the hull at a point below the load water line in order to keep the lift of the dense material as low as practicable. In view of the resistance of drag pipes when running at 13.4 knots loaded, several designs were made and tried out in the Experimental Model Basin, at the Washington, D.C., Navy Yard. For the purpose of reducing this resistance and at the same time maintaining a simple and practical design, the sponson was streamlined and a fair water added to the pipe. The addition of the appendages, however, resulted in an increase of resistance of 17 per cent. over that of the bare hull.

Numerous model tests were made of the vessel itself; the bare hull was run as for any normal vessel. It was also tested with hopper openings cut in the bottom, then with shaft bossings and rudder added and, finally, with the drag pipes added. Thus it was possible to determine the effect of each factor by itself and to see whether any modifications were justified. Self-propelled tests were conducted at light and loaded draft and with all appendages fitted. Manœuvring tests were also made to determine the steering and handling qualities of the vessel in working conditions at various drafts and speeds, when steered by its own rudders and also with the assistance of the propellers.

Manœuvrability

The ease of manœuvring a vessel of this type is a matter of great importance. Running to sea with a load and returning to the dredging site in the harbour or channel is done at the vessel's full available power. When dredging, however, the vessel is slowed down to two or three knots, at which speed it must work along and across channels, turning or reversing frequently. Hopper dredgers must, therefore, handle with ease at low speed, and must also be able to turn quickly at any time to avoid danger or collision while working in a busy channel. The twin screws and twin rudders assist in quick changes of course; but to make sure of this quality, the stern was modelled after one of the dredgers now in service, which was found on trials and in operation to handle with remarkable ease. This stern is different from that usually found on twin-screw ships. There is no skeg; instead, a long cutaway is provided, beginning at the keel about 70-ft. from the point where the stern profile crosses the load waterline. This cutaway runs upward rather steeply nearly to the load waterline, then rounds off gradually into a cruiser stern. The after sections are distinctly triangular in shape, with no hollow except locally at the end of the flat keel. The waterlines of the stern are gently rounded into natural endings along the rise of the cutaway; and the buttocks aft are generally parallel to each other and to the line of the cutaway, without a trace of hollow.

The bossings for the propeller shafts were given careful attention, since the form of stern was unusual. The bossings were kept as small as practicable, and located and shaped in such a way as to reduce their resistance to a minimum.

Watertight Bulkheads

The dredger is designed for a two-compartment standard of sub-division, being divided by twelve watertight bulkheads extending from the hold to the main deck. The absence of doors below the main deck will be noted, there being only two 26-in. by 66-in. vertical sliding watertight power-operated doors fitted in the hold, one between the boiler and engine room, and one between engine room and shaft alley.

These two doors are operated electrically from the pilot house. Individual valves are provided for local operation of each door, and they can also be operated by hand from the main deck through gears. Electric alarm bells and visible signals to indicate operation are located at each door.

Toward the furtherance of safety, additional escapes, in the form of vertical ladders inside of large ventilator trunks, with doors at the upper deck, have been provided in the dredger pump room and the shaft alley.

Ample provision has been made for the escape of the men on duty below the main deck, should need require them to make a hasty exit.

*Reproduction of Paper read before the Society of Naval Architects and Marine Engineers, New York, U.S.A., in November, 1941.

Sea-going Hydraulic Hopper Dredgers—continued

Officers' and Crew's Accommodation

Quarters for the seamen are arranged forward of the hoppers, on the main deck, with corresponding quarters aft and adjacent to the galley and mess roms for the cooks and waiters. The officers and the remainder of the crew are located on the upper deck, boat deck and bridges. Every effort has been made to locate as many of the men above the main deck as possible, so as to get them away from the noise of the machinery, assuring them of quiet for rest and recreation.

The quarters are commodious, the officers having individual rooms, while the crew is berthed in separate rooms, not more than four men to a room, with liberal toilet and shower facilities close to the rooms Not more than eight men will use any one toilet or shower, while wash-basins are fitted in each room except for the seamen, where a common wash-room has been provided with six basins for 32 men. Recreation rooms for officers and crew are furnished with tables, chairs, settees and bookcases. All of this constitutes a decided advance in comfort for the personnel of vessels of this class.

Ambrose Channel Suction Head or Drag. Named after one of the entrance channels to New York Harbour where it originted and was first successfully used. The bottom grid is renewable when worn. Many adaptations of this drag are in use on different sea-going hopper dredgers. Some have controlled opening on top of the hear casting to admit water in case the suction becomes ovre-loaded. Others have had various kind of sacrifiers cast or fastened to the bottom of the grid.

Modern fireproof construction marks the steel joiner construction of the quarters. All berths, furniture, outside and inside doors, windows and frames are of steel. All surfaces in the quarters that are exposed to the weather are heat insulated, and the decks in the officers' and crew's quarters and recreation and hallway spaces are covered with magnesite. The decks in the toilets and wash-rooms are covered with cement, tinted to a terra-cotta red.

The present complement is 115, but provision has been made 16 additional, a total of 131.

Mess Rooms and Galley.

The galley is provided with modern equipment, including electric ranges, automatic baking oven, steam kettle, hot water tank, dough mixer and trough, potato peeler, motor-driven meat and coffee grinders, a 26 cubic ft. refrigerator for the cooks' daily supply, and corrosion-resistant steel work tables, shelves and dish racks.

The pantry, located adjacent to the galley, is provided with two steam tables, a bread locker, toasters, electric egg boiler, electric griddle, coffee and hot water urns, and two small refrigerators, with corrosion-resistant steel work tables, shelves and dish racks.

Food is served from the pantry, which has direct access to the three mess rooms. The officers' mess is located on the left side and seats 18; the petty officers' mess is located on right side and seats 36; the crew's mess, also located on the right side, seats 44 men. Each mess room is provided with a sideboard; all of the furnishings are of steel and the table tops are of micarta.

The refrigerator rooms and galley stores are located on the after lower deck, under the galley space and with direct access to the pantry.

General Description of Machinery

The main machinery consists of turbo-electric power generating equipment, with principal characteristics as follows:

Propulsion shaft horse-power, normal full power	7000
Number of screws	2
Propeller revolutions per minute at normal full power	112
Dredge pump, horse-power, normal full power	2600
Number of dredger pumps	2
Steam pressure at throttle, pounds per sq. inch.	435
Steam temperature at throttle, degs. fahr.	740
Condenser vacuum, inches	28½

Power is supplied by two main turbo-generator units, and the propeller shafts and dredge pumps are each driven by direct-connected electric motors.

Steam is supplied by two water-tube, oil-fired boilers equipped with automatic combustion control.

The auxiliary machinery installation includes a standby turbo-generator unit for port service; an emergency Diesel generator unit; an auxiliary condenser; evaporators and distillers; a refrigerating plant; pumps; heat exchange equipment; tanks and other auxiliary equipment necessary for proper operation.

Each main turbo-generator turbine with reduction gearing, driving three direct-current generators connected in tandem. One generator of each unit supplies power to its propelling motor, one to a dredge pump motor, and one is for auxiliary machinery, lighting and other ship's services.

Each turbine and gear is capable of delivering a normal full load output of 4,400 brake horse-power at the gear shaft, and a maximum output of 25 per cent. in excess of normal full load.

There are two main condensers of the horizontal, single-pass, surface-condensing type, each having about 3,800 sq. ft. of cooling surface with a distance between tube sheets of 12-ft. Each condenser is capable of maintaining a vacuum of 28½-in. at its inlet flange when condensing steam from its main turbo-generating unit under normal full load conditions of 4,400 brake horse-power output, and with 9,500 gallons per minute of circulating water supplied at 70 degs. fahr.

Each condenser is mounted fore and aft beneath its turbine and is hung from the turbine foundations. The condenser is entirely supported from above by means of straps or brackets bolted to suitable supporting members attached to the underside of the turbine foundation beams.

There is one auxiliary condenser of the horizontal, two-pass surface-condensing type, having about 400 sq. ft. of cooling surface and a distance between tube sheets of 8-ft. The auxiliary condenser is capable of maintaining a vacuum of 25-in. at its inlet flange when condensing steam from the standby turbo-generator under full load conditions of 300 brake horse-power output from the unit, and with 400 gallons per minute of circulating water supplied at 70 degs. fahr.

The condenser is mounted and hung from the foundations in the same manner as the main condensers.

Steam-Generating Plant

The steam generating equipment consists of two single-pass, sectional-header water-tube marine boilers with side water walls, air heaters, superheaters and desuperheaters. The boilers are arranged to burn oil under forced draft with open fire room. They are designed for a maximum working pressure of 500 lbs. per sq. in. and are suitable for the following operating conditions when burning 18,500 B.t.u. oil:

Normal evaporating rate, superheated steam, pounds per hour per boiler	37,500
Superheater outlet pressure, pounds per sq. in.	450
Superheater outlet temperature, degs. fahr.	750
Feed inlet temperature, degs. fahr.	310

Sea-going Hydraulic Hopper Dredgers—continued

The design makes use of the economies now obtainable in the production of steam. A boiler efficiency of 87 per cent. is not an unreasonable expectation and it is practicable to produce an equivalent evaporation of water from 18,500 B.t.u. of 16.6 lbs. of water. It is expected that only 0.697 lb. of oil will be required per shaft horse-power per hour.

The desuperheater installed in each boiler is capable of delivering 3,000 lbs. of steam per hour with a residual superheat not exceeding 50 degs. Fahr.

There are three stages of feed water heating. The first stage heater is supplied with low-pressure bleeder steam; the second stage heater, of the de-aerating type, is supplied with auxiliary exhaust steam, and the third stage heater is supplied with high-pressure bleeder steam.

Main Generators

The three generators connected in tandem to each turbine unit consist of a propulsion generator rated at 2,800 kw., 600-volts., direct current, separately excited, shunt wound, direct connected to a propulsion motor; and a generator rated at 1,050 kw., 500-volts., direct current, direct connected to a dredge pump motor. In addition to a separately excited shunt field on the latter generator, there is a self-excited shunt field and a differential series field which give a drooping voltage characteristic, such that, if the load on the dredge pump motor is reduced because of a choke in the suction line of the pump, the generator voltage will increase into a ratio so that when there is a 130 per cent. increase in voltage the current is zero. This characteristic results in a corresponding increase in motor speed and a temporary increase in horse-power, tending automatically to eliminate the choke. The third generator, for auxiliary power, rated at 300 kw., 240-volts., is shunt wound and operates in parallel with the generator of the other unit. Voltage regulation and the balancing of load between the two auxiliary generators are provided for by the use of regulators of the non-vibrating type.

It will be noted that the installed generator power is in excess of the power furnished by the turbine. The design calls for full turbine power, less electrical losses and non-dredging auxiliary requirements, to be applied to the propelling motors when the vessel is under way to and from the dumping grounds. It was considered expedient to employ this arrangement of generators rather than one whereby the dredger pump generator could be used when additional power was required for propulsion. To do the latter, considerable switch gear equipment would have been required, with the necessity, on the part of the engine-room force, of arranging for the alternate circuit set up at the start and completion of each dredged load. Under dredging conditions the power required for propulsion is on the order of 40 to 60 per cent. of that which is required at full speed.

Propulsion Motors

A motor rated at 3,500 h.p., 110-120 r.p.m., 600-volts, of the single-armature type, is connected to each propeller shaft. Separate excitation is supplied from the 240-volt auxiliary bus on the main switchboard. The motors are individually controlled at any speed from 0 to 120 r.p.m. in either direction of rotation by varying the field excitation of their respective generators and their own field excitation. The propelling motors may be controlled from two stations on the vessel, one at the main switchboard, and the other in the pilot house, subject to selection at will by means of a transfer switch on the main switchboard. In normal operation, including docking the propelling motors are controlled from the pilot house.

Dredger Pump Motors

The two dredger pumps, one right and one left-hand, are installed in the dredger pump compartment. A motor rated at 1,300 h.p., 200-250 r.p.m., 500-volts, shunt wound and separately excited, is directly connected to each pump. The speed range ib obtained by shunt field control. Each pump motor armature is directly connected to its generator and the speed of 0 to 200 r.p.m. is controlled by varying the generator voltage.

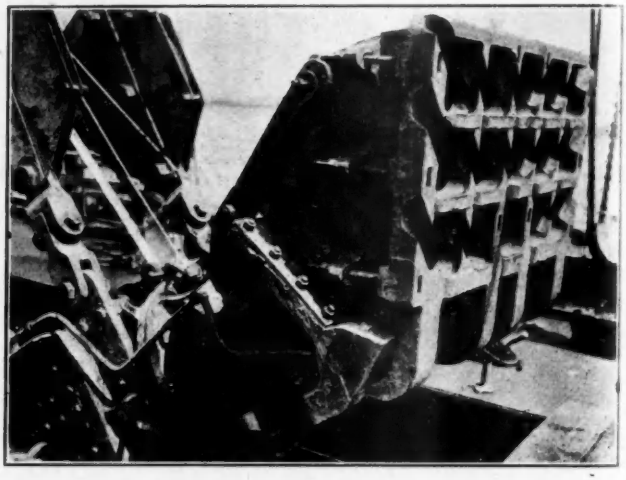
The control of pumps is in the hands of the drag tenders, thereby relieving the engine-room force of this duty.

Dredging Pumps

The heart of a dredger, and about which everything else centres is the dredging pump. Time does not permit a technical treatise of the two pumps, right and left, which will handle the various materials coming into the hoppers of this latest design for long haul dredging.

The pump shell, lined with special abrasive resisting metal on both heads, utilises a 5-ft. 9-in. shrouded, specially hardened, 5-vaned impeller. This impeller is screwed on to the pump runner shaft which is direct connected to a shunt wound separately excited motor of 1,300 h.p., having a speed range from 0 to 200 r.p.m. The pump suction is 32-in. in diameter and the discharge is 30-in. in diameter.

The suction side of the pump is connected through the hull to the side suction pipe which terminates in the suction or drag head. Since the discharge is not long, being close to the hoppers, it is necessary that particular attention be given the design of the suction side of the pump to get full benefit of the lifting power of the vacuum.



Pacific type drag head, developed and used to good advantage on certain dredgers of the Pacific Coast. It has been able to increase percentages of solid materials in many instances.

In this case a total suction length of 107-ft. is involved, which, with necessary bends, represents a fixed friction loss. Ninety-three cub. yds. of solid material pass through it per minute.

To keep the entrance losses to a minimum and to provide for a proper contact and connection between the pump and the spoil to be dredged, much thought has to be given to the drag head.

Many drag heads have been designed—some patented. The one most commonly in use is the so-called Ambrose Channel drag, which originated in New York Harbour and has been evolved to suit changing conditions to reduce entrance losses and at the same time secure a maximum percentage of material, without admitting obstructions, and provide admission of the proper amount of water to prevent choking. The proportioning of the openings in the grating or bottom of the Ambrose Chaannel drag head varies from $2\frac{1}{2}$ to $3\frac{1}{2}$ times that of the pipe cross-section. Since this part—weighing approximately 7 tons—is affected by the abrasive action of the materials dug, its bottom is ordinarily made replaceable.

There is also shown the so-called Pacific type of drag head, which has been used to advantage on the Pacific Coast dredgers of this type and which is being tested for certain kinds of material in our eastern rivers.

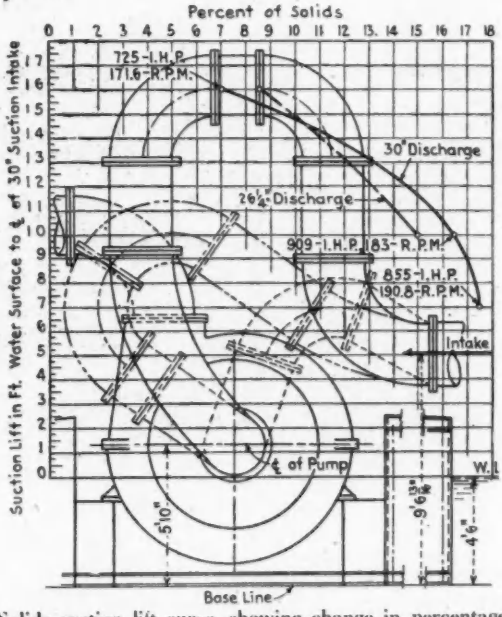
Other losses which enter the suction side of a dredging pump are the direct head losses or lift. This problem must be considered in conjunction with power and speed problems of the designers, for the ideal suction lift condition can be secured only at the expense of either loss of vessel speed or added propulsion power. To secure the most desirable lift conditions special tests were undertaken.

Sea-going Hydraulic Hopper Dredgers—continued

Pumping Tests

One of the power problems is to proportion the power between the dredging pump and the propeller to secure the maximum percentage of solid material in such a manner as not to interfere with the speed of the vessel.

This can best be illustrated by the manner in which power limits were approached in the arrangement for the dredging pump on Hull No. 226. The problem boiled down to securing exact pump suction placements—one on each side of the hull—which would interpose the least amount of interference with the speed of the dredger when loaded. If the point where the suctions, with their projecting and protecting sponsons, entered the hull could be raised above the load line, no resistance would be offered by them to the speed of the vessel en route to the dump and a minimum propulsion power requirement entailed. On the other hand, if the pump and point of suction entrance were lowered in the hull so that both were completely submerged at the light load draft, a minimum power on the pump would be required and easy priming and a high percentage of solids secured, but at the expense of propulsion power.



Solids suction lift curve, showing change in percentage of solid materials as height of suction lift increases.

No worthwhile data being available on this essential point, it was necessary to reproduce as far as possible the various conditions to determine the economical limits of lift on the pump suction. To this end comparable conditions were reproduced on a pump barge operating on the Mississippi River.

The distance of suction above the water was varied, representing the distance above the light load line at which the suction would enter the hull. Actual operations determined the desirable ratio of percentages of solids, "pay dirt," to height of suction above water. The most desirable position for suction entrance as far as minimum propulsion power was concerned was found incompatible with yardage procurement. It was then necessary to fix a desirable suction entrance point which was found to be below the high water line. The problem thus became one of securing the maximum speed lines with the dredging obstructions fixed.

Drag Pipe, Davits and Appliances

The dredger is unique not only in its dredging capacity but in the power and the methods applied for operating and controlling the dredging plant. Approximately 130-ft. aft from the bow on each side, there is a streamlined sponson for carrying the upper ends of the two drag pipes and the outer section of the dredger pump suction pipe connected to it. Mounted on the sponsons are bearings which carry the trunnions of the drag pipes and act as the pivot for the angular movement of the drag. The drag pipes are constructed in sections and have an inside diameter of 32-in. A ball joint is located in the pipe for lateral displacement.

When dredging, the pipe and drag head are lowered to the channel bottom at angles up to 45 degs., depending on depth, and are dragged along by the dredger at a slow speed. The position of the drag heads in relation to the bottom is controlled by two men, drag tenders, who operate the winches connected to the drag hoist hung from two davits installed on each side of the dredger for raising and lowering the drag pipes. The controls for this operation are located in the drag-tended houses at the after corners of the bridge deck.

There are four drag hoist davits, two on each side of the dredger. The forward davits are non-topping, with sufficient outreach to handle the ball joint. The topping of the after davits is of the screw type, operated by motors driving each davit screw through transmission gearing. The davit screw telescopes within a tube in which the actuating nut is secured. Jaw type positive stops are provided on the nut and on the screw to arrest rotation of the screw in the event the limit switches fail to function and there is danger of over-travel. As there is a constant tendency to sudden shocks, the top hoisting block is fitted with a spring shock absorber, designed for a deflection of 8-in. under a load of 50,000 lbs.

For raising and lowering the dredger pump suction pipe, there are two hoisting winches located on the main deck in the dredger pump compartment. Each winch is of the motor-driven tandem double-drum type, and the drums are of such diameter and speed that the two hoisting ropes will lift the suction pipe on a straight line. There is a difference in length of rope due to the angle of the pipe and the location of the lifting davits 56-ft. apart. The large drum has a rope speed of 160-ft. per minute and a rope pull of 20,375 lbs., while the small drum has a speed of approximately 75-ft. per minute and a rope pull of 14,050 lbs., all figured on the basis that the top of the chain bridle attached to the suction pipe at the drag head will have a vertical travel of 40-ft. per minute.

The movement of each drag pipe is individually controlled and in order that the movement can be closely regulated, a motor generator is employed having a generator for each of the drag hoist motors. The variable voltage system is used and the control mechanism has been designed to secure ease of operation amounting to finger-tip control of the position of the drag head.

The dredger pumps are located in the hold, 130-ft. aft from the bow, and discharge through two separate 30-in. steel pipes. These pipes extend aft over the hoppers on each side of the centre line. In each pipe there are eight discharge nozzles fitted with gates operated by a screw mechanism from the fore and aft walkway extending over the hoppers. In each discharge line forward of the first nozzles there is a flap valve weighted and balanced so that the valve will remain in an open position when discharge material is passing through. In way of each discharge nozzle a baffle plate is fitted to break the force of the pump discharge. The discharged material is then received in a trough that extends for the full length of the hopper space. This trough is perforated with a system of staggered holes, ranging from 2-in. to 12-in. in diameter through which the dredged material passes into the hoppers.

The eight hoppers, four on each side of the centre line of the dredger, are 23-ft. wide and 42-ft. 6-in. long, with two openings in the bottom. The lower part of the hoppers is sloped from the surrounding bulkheads and from the intermediate hips to carry the dredged material to the openings. Closure of the openings is made by cast-steel doors, made semi-watertight by live rubber gaskets extending around a cast-steel frame. Each hopper door operating gear consists of a separate mechanism, fitted with gears in the head of a vertical shaft, transmitted through a horizontal shaft, transmitted to a motor and brake. The horizontal shaft is extended beyond the hopper coaming and is fitted with a large wheel for hand operation.

The entire dumping gear is supported over the hoppers by girders. These girders also support the walkways.

In order to rid the hopper spaces of the water which accompanies the dredged material, overflow troughs and chutes are built into the dredger. These troughs extend longitudinally for the

Sea-going Hydraulic Hopper Dredgers—continued

length of the hoppers with their upper edges at the level of the designed capacity of the hoppers. These troughs collect the water as the solid dredging material settles to the bottom of the hoppers. From the bottom of the troughs, eight discharge chutes, located on each side of the dredger, lead the water outboard through the shell of the dredger.

The forward anchor windlass is of the spur-gear, motor-driven type with a capacity sufficient to lift two 11,000 lb. anchors and two 20-fathom lengths of 2¼-in. chain at a speed of four fathoms per minute. Two 18-in. diameter by 20-in. long whelped winch heads are located on the second reduction shaft.

The after anchor windlass is of the vertical, motor-driven type, having sufficient capacity to lift one 4,000 lb. anchor and one 20-fathom length of 1 7/16-in. chain at a speed of four fathoms per minute.

Two single-barrel, gypsy-type, motor-driven capstans are located on the after upper deck, each having a line pull of 13,000 lbs. at the barrel with a line speed up to 88-ft. per minute.

The foremast is rigged for a 5-ton boom to handle dredging gear. The mainmast is rigged on the forward side for a 5-ton boom to handle engine-room machinery, and a 3-ton boom on after side to handle stores. Each boom is operated with a double-reduction, spur-gear, motor-driven winch fitted with a centre drum and two gypsy heads, having a capacity of 5,000 lbs. on a single line pull at a rope speed of 100-ft. per minute, and 6,000 lbs. at a reduced rope speed.

Each of the four kingposts is rigged for a 10-ton boom, for handling the hopper dredging gear and suction pipes; the two forward kingpost booms will also handle the dredger pump machinery. Each boom is operated with a motor-driven tandem double-drum winch having a capacity of 10,000 lbs. on a single line pull at a rope speed of 100-ft. per minute.

The four 55-man lifeboats are of metal construction; the work boat and utility boat are of wood. Each boat is furnished with a set of mechanical boom-breasting, screw-type davits. Totally enclosed watertight motor-driven hoists, one right and one left, are provided for operation of the lifeboat and work boat. The utility boat has a separate motor-driven winch, capable of lifting it at a speed of 15-ft. per minute.

The steering gear is of the electric hydraulic type, with opposed rams, actuated by dual pumping units, for operating twin rudders. The reversible hydraulic pumps are arranged so that instant change from one pumping unit to the other may be made. The automatic follow-up is so designed that should excessive pressure on the rudders open relief valves and cause the rudders to slip, they will automatically return to normal position relative to the rudder indicator. The steering has a capacity for moving both rudders simultaneously from hard-over to hard-over, through an angle of 70 degs. in not more than 30 seconds, at an assumed vessel speed of 19.5 knots.

Ventilation

Mechanical ventilation has been designed for three groups of spaces independently: (1) Quarters, (2) toilet and wash rooms, and (3) galley, scullery and pantry.

The living spaces have an air change every four minutes, the toilets and wash rooms every three minutes and the galley, scullery and pantry every two minutes.

The mechanical ventilation consists of electrically driven, non-overloading, direct-connected, quiet operating, centrifugal and axial flow fans capable of producing the required capacities and static pressures. All ventilation fans of the centrifugal type are provided with 25 per cent. speed reduction. Outlets in the living spaces are designed for quiet, diffusing discharge with adjustable volume control dampers.

Natural exhaust from those spaces having mechanical supply, flows through ample door louvers or undercuts at the toilets and wash rooms, the total capacity of the opening balancing the mechanical supply. Mechanical exhaust has been provided for those spaces where the natural exhaust would not be effective.

Ventilation systems for machinery spaces, generators and propulsion and dredger pump motors are provided as follows:

Engine room; mechanical supply and exhaust;

Boiler room; natural supply and mechanical exhaust through forced-draft blowers;

Dredger pump motors; mechanical supply;

Propulsion motors, from weather deck;

Propulsion and dredger pump generators, exhaust to weather deck.

Conclusion.

The result desired from the design of Hull No. 226 is a vessel economical in operation for long hauls and capable of dredging in moderately rough weather in exposed harbours and bays.

Further study is being made of the drag pipe and sponson arrangement to determine whether the resistance inherent in the present design can be reduced. This study will include additional tests in a model testing basin to verify the results of previous tests and to determine the increase in speed that may be expected to follow a different arrangement for handling the drag pipes.

The naval architects and marine engineers of the Marine Division, Corps of Engineers, and of the Fore River Yard of the Bethlehem Steel Company, Shipbuilding Division, collaborating in the design, know that they have achieved a forward step in marine engineering and through these endeavours furthered the economical development of United States ports and their commerce.

Review

The Reminiscences of a Civil Engineering Contractor, by Robert Brodie, M.Inst.C.E. Pp. 106, with 3 plates. Price: 7s. 6d., plus postage. Bristol, 1942, John Wright & Son, Ltd., 28, Orchard Street.

There are few busy lives, especially if they reach or exceed the allotted span of human existence (according to the Psalmist, three-score years and ten) which do not contain noteworthy experiences of one kind or another. Civil Engineering, as a profession, is a field particularly fertile in interesting experiences, and Mr. Brodie's record bears witness to this fact. Having happily far exceeded the normal span of life and having been engaged on some of the most varied and important engineering undertakings in this country, he has a good deal to say which cannot fail to be of interest and value. His 65 years of active service have been spent in the construction of railways, harbours, docks, roads, viaducts, bridges, reservoirs and Catchment Board improvements, mainly in association and partnership with the late Mr. L. P. Nott, in the well-known contracting firm of that name, afterwards Nott, Brodie & Company.

The dock and harbour sections will make the strongest appeal to our readers, and it may be said that the list includes the Fraserburgh and Peterhead Harbour Improvements (1895-97), Dry Docks and an Entrance Lock at Swansea (1897-1900), the Canada Dock, No. 2 at Liverpool and Tranmere Dock at Birkenhead (1900-1908), Wicklow Breakwater, Wick Harbour Improvements, South Shields Graving Dock, Widnes Dock Lock and other contracts in the Birkenhead and Bromborough area (1908-14).

At the end of the book are three useful appendices: one on specifications, in which the particular requirements of some engineers are criticised; the second, an address given to pupils of secondary schools, mainly on civil engineering as a profession, and the third, a Geometrical Solution of the Labour Problem, which was published as an article in this Journal in 1921.

The book, however, has not only technical value, it has human interest, with its account of the personal idiosyncracies of various individuals, some distinguished and some obscure, with whom the author came in contact, and a number of entertaining anecdotes about them. At the ripe age of 82, the author describes himself as still hale and hearty (indeed, referred to at his club as " Young Brodie ") and we cannot conclude this notice better than by wishing him many more years of activity to furnish equally happy memories.

The Port of Wilmington, North Carolina

Pre-war Port and Harbour Conditions

(Concluded from page 203)

Port Labour

The supply of labour available for water-front work is reputed to be more than adequate to meet requirements of terminal operators and local industries. Longshoremen available for daily call approximate 600, of which about 150 are experienced workers capable of handling any type of cargo.

As a rule men are hired and gangs are shaped at piers where work is to be performed. Occasionally stevedore contractors hire men for future work or work at distant piers at their water-front offices or at general concentration points. Foremen are hired by the stevedores directly and are usually allowed to make up their own gangs in accordance with stevdore's instructions as to number of men wanted.

With the exception of labour employed by coastwise lines and several privately-owned industrial facilities, longshore labour is organised and affiliated with the International Longshoremen's Association. Regular longshoremen are seldom employed at coastwise lines' terminals or at industrial plants' facilities, since cargoes at these wharves are generally handled by regular employees of the operating company.

The following extracts from the agreement between Local No. 1426, International Longshoremen's Association, and contracting stevedores indicate wages and working conditions in effect at the port.

The basic working day consists of 8 hours and a working week of 48 hours. Men will work nights, Sundays and holidays, whenever necessary. Holidays observed are New Year's Day, July 4th, Labour Day, Thanksgiving Day and Christmas Day.

Wage Scale.—Rates of pay are as follows:

	Sulphur and Cement		Other Cargo	
	Straight time per hour	Overtime per hour	Straight time per hour	Overtime per hour
Holdmen	$0.48	$0.72	$0.43	$0.65
Hatch tenders ...	.53	.80	.48	.72
Hatch foremen ...	.58	.87	.53	.80
Winchmen	.58	.87	.53	.80
Sewers and clean-up men	.43	.65	.38	.57
Water boys	.38	.57	.33	.50

Straight time shall constitute any 8-hour period between the hours of 7 a.m. and 4 p.m. or 8 a.m. and 5 p.m., at the option of the stevedore. All other time, including Sundays and holidays, will be paid for at the overtime rate, except that on Labour Day and Christmas Day the men shall be paid double the basic straight-time rate.

When men are required to work into customary meal hour to finish a ship within the meal hour, they shall be paid straight time only. However, should ship not be finished within the meal hour, overtime shall commence at the end of the meal hour and continue until men are relieved.

Men are not to lose any time for waits due to switching unless exceeding half-an-hour. In such a case and whenever men are required to wait for any other reason after ship begins work, except weather conditions, they are to receive half-pay only.

For discharging cargo that has been damaged by fire and/or water used to extinguish fire they are to be paid double the prevailing rate.

When men are not paid upon completion of ship or at end of day's work they must be paid Saturday afternoon for all time made prior to 6 p.m. Friday However, if men have not had any work previous to Friday, they shall be paid off up to 6 a.m. Saturday.

In the event of any dispute or controversy arising the men shall continue to work pending an adjustment of the trouble by a committee of four representing employer and employee equally. A decision of the majority of this committee is final and binding on both employer and employee.

Longshoremen are prohibited from working for any individual corporation, or firm not signing an agreement with the International Longshoremen's Association, while employers are to give preference in employment to union members.

Methods Employed in Handling Cargo

All vessels arriving from foreign ports are permitted to proceed directly to berths designated by their local agents where they will be boarded by the medical officer appointed by the Public Health Service for the usual quarantine inspection. After vessels have been granted pratique they are boarded by customs and immigration officers for inspection of ships' papers, cargoes, stores, crews, and passengers. If preliminary entry has been made, cargoes may be unloaded under surveillance of customs inspectors but must not be removed from pier until formal entry has been made.

When vessels are berthed at public facilities, agents usually arrange with contracting stevedores to handle cargo, while those berthing at private industrial facilities are generally discharged by plant employees. In the former case vessels are expected to have booms rigged and winches in good working order when stevedores take over. Longshoremen will remove hatch covers and perform any special rigging that may be necessary and unload cargo to pier. Bulk cargo is usually released by the stevedore at the end of the ship's tackle or if pier cranes are used as soon as it is landed on pier. Terminals usually backpile such cargoes by belt conveyors, overhead tramways or by terminal labour. Package freight is generally deposited in transit shed by stevedore's dockmen. Outward cargo is taken from place of rest in transit shed or on pier, transported to ship's tackle and loaded into and stowed in ship's hold.

Cargo is tallied by checkers employed by the stevedore for the ship's account. Terminals also check cargo unloaded and placed in transit shed or storage and will give the ship a receipt for all cargo so placed, while cargo loaded direct from ship to cars is tallied by railroad checkers and receipts given to vessel.

All cargo except fertilizers, petroleum and other materials in bulk, and that moving via coastwise vessels, is handled by ship's tackle. Coastwise vessels handle goods by hand trucks and tractor-trailers through side ports.

Fertilizer and other dry bulk materials, however, are discharged as far as possible by mechanical hoisting gear and back piled by tram cars operating on an overhead truck system from apron to storage space. The following table shows the mechanical discharging installations available at the port:

Operator	Type	No.	Capacity per hour tons each	Reach feet
Atlantic Coast Line Pier (Nitrate Agencies Co.) ...	Bucket hoist ...	1	35	35
Seaboard Air Line Piers B & C (Wilmington Terminal Warehouse Co.)	" ...	4	50	35
Seaboard Air Line Piers D & E (Wilmington Terminal Warehouse Co.)	" ...	1	35	35
Wilmington Terminal Warehouse Pier	Bcket elevators	3	120	—
Atlantic Coast Line Railway Wharf	Bucket hoist ...	1	35	35
Josey's Wharf	" ...	1	35	35
Swift & Co. Wharf	" ...	1	35	35
American Agricultural Chemical Co. Wharf ...	" ...	1	35-50	30
East Coast Fertilizer Co. Wharf	" ...	1	35	35
Virginia Carolina Chemical Co.	" ...	2	35	35
Armour Fertilizer Works ...	Travelling crane	1	60	35
F. S. Royster Guano Co. ...	Hunt tower ...	1	50	40

Port of Wilmington, North Carolina—continued

Ship's tackle equipped with dump buckets discharging into movable hoppers is used to supplement pier equipment by working hatches not served by the pier's equipment. Tractors, trailers and dump carts are used for shifting and/or delivery of commodities to carriers from storage or vice versa.

With the exception of a few minor facilities on the western shore of the Cape Fear River all of Wilmington's water front facilities can be served by rail. A few do not have spur connections but in such cases the tracks of the " Belt Line " are within easy trucking distance of the face of wharf and transit shed. The larger terminals are equipped with spur lines serving both the warehouses and ship side.

Trucks are seldom permitted to drive directly to cargo pile on pier. Loading platforms are available and it is the practice for the terminal to perform all handling in connection with the movement of cargo to or from the truck, including the loading or unloading.

Internal Trade Territory

According to local traffic experts, the greater part of Wilmington's foreign water-borne commerce originates in or is distributed to " local territory," in which transportation rates to or from Wilmington are lower than those to any other seaport. This local territory includes roughly an area delimited by drawing a line north-westerly from Pamlico Sound through the cities of Vendemere, Wilson, and Durham to Mount Airy, thence south-westerly to the Tennessee border in the vicinity of Huntdale, North Carolina, thence south-easterly through or near Asheville and Henrietta, North Carolina, and Rock Hill, Lancaster, and Florence, South Carolina, to a point on the coast about midway between Wilmington and Charleston.

Occasional small shipments move between the port and Florida, Georgia, Tennessee, Kentucky, Indiana, Ohio, and West Virginia, but these in aggregate amount to less than 5 per cent. of the port's total foreign trade.

Foreign Trade Territory

Comparison of the import and export trade of Wilmington during 1938 with the trade of 1921 and 1933 indicates that some significant changes have taken place. The following table shows the importance of fertilizer in the port's trade and the development of diversification in commerce from 1921 to 1938:

Imports by Commodities.
(In cargo tons of 2,240 pounds).

	Rank	1938	Rank	1933	Rank	1921
Fertilizers ...	1	155,706	1	124,914	1	50,152
Sugar ...	2	14,824	2	12,132	—	—
Creosote ...	3	10,760	—	—	—	—
Bags and bagging	4	2,481	4	315	—	—
Plaster ...	5	1,980	—	—	—	—
Molasses ...	6	1,945	—	—	—	—
Chemicals ...	7	1,694	5	23	2	134
Logs and lumber ...	—	—	3	2,352	—	—
All other ...	—	1,171	—	1,059	—	—
Total Imports ...	—	190,561	—	140,795	—	50,286

The following table showing the export trade during the years under discussion indicates that the greatest change occurred in the loss in the cotton trade and in the rise in exports of scrap iron, oil cake, fertilizer, and a revival of tobacco exports:

Exports by Commodities.
(In cargo tons of 2,240 pounds).

	Rank	1938	Rank	1933	Rank	1933
Metal scrap ...	1	33,096	—	—	—	—
Tobacco leaf ...	2	12,897	2	4,656	—	—
Fertilizers ...	3	3,037	—	—	2	2,234
Oil cake ...	4	1,112	—	—	—	—
Cotton ...	5	1,000	1	7,754	1	22,388
Rails and track	6	670	—	—	—	—
Logs and lumber ...	—	—	3	525	—	—
All other ...	—	—	3	275	—	275
Total export	—	51,802	—	13,219	—	24,897

The following tables showing origin of imports and destination of exports for the calendar years 1921, 1933 and 1938, indicate changes that have taken place in the foreign trade territory of this port since the publication of the original volume in 1921. The increase in total imports was marked by larger movements from Chile, Germany and Cuba and by receipts from countries not contributing to the trade in 1921. In the export trade Italy, England, Netherlands and Germany retained their positions as Wilmington's most important export markets.

Imports by Countries of Origin.
(In cargo tons of 2,240 pounds).

	Rank	1938	Rank	1933	Rank	1921
Chile	1	102,873	3	27,314	1	39,441
Germany ...	2	28,507	2	28,346	3	3,086
Cuba	3	14,824	4	13,101	—	—
Netherlands ...	4	13,237	1	37,465	—	—
Belgium ...	5	10,660	6	7,352	2	6,384
Norway ...	6	5,513	9	1,960	—	—
England ...	7	5,078	10	1,790	—	—
India	8	2,479	14	315	—	—
Canada ...	9	1,980	—	—	—	—
Lesser Antilles	10	1,945	—	—	—	—
Peru	11	1,528	8	2,427	—	—
Spain	12	1,476	7	7,309	—	—
Japan	13	461	5	9,978	—	—
Portugal ...	—	—	13	640	—	—
Italy	—	—	15	90	—	—
Union of South Africa ...	—	—	12	1,026	—	—
Phillipine Islands ...	—	—	11	1,682	—	—
France ...	—	—	—	—	4	1,375
Total imports	—	190,561	—	140,795	—	50,286

Exports by Countries of Destination.
(In cargo tons of 2,240 pounds).

	Rank	1938	Rank	1933	Rank	1921
Italy	1	16,158	1	4,634	1	10,727
England ...	2	12,897	2	4,611	3	3,102
Netherlands ...	3	9,647	4	428	4	2,255
Germany ...	4	7,281	3	2,949	2	6,187
South China ...	5	3,037	—	—	—	—
Denmark ...	6	1,112	—	—	—	—
Poland ...	7	1,000	7	80	—	—
Union of South Africa ...	8	670	—	—	—	—
Ireland ...	—	—	6	82	—	—
Scotland ...	—	—	8	18	—	—
Belgium ...	—	—	5	408	—	—
France ...	—	—	—	—	5	1,990
Spain ...	—	—	—	—	6	605
Total exports	—	51,802	—	13,219	—	24,866

Intercoastal Trade

Intercoastal trade of Wilmington for the calendar year 1938, showed considerable decline in total tonnage from the 46,937 tons reported during 1933. In 1933 the entire trade consisted of receipts from the Pacific Coast ports while in 1938, 2 per cent. of the total consisted of shipments, the remaining 98 per cent. having been receipts.

The principal cause for the large decline in east-bound tonnage may be traced to the virtual disappearance of petroleum from this trade. In 1933 this commodity accounted for 32,945 cargo tons or 70 per cent. of the total while in 1938 receipts amounted to only 52 cargo tons or less than 1 per cent. of the total. However, increased movements of animal, fish and dairy products, fruits and vegetables, and lumber helped offset this loss in tonnage.

Establishment of Free Port at Beira.

A commission has been appointed by the Portuguese Government for the purpose of studying the conditions under which the Port of Beira should operate as a Free Port. The Commission is composed of the Director of Customs, who acts as president; a representative of the company holding the concession for the exploitation of the port; a representative of the railway companies; a representative of the economic activities of the town of Beira; the engineer in charge of the technical department of Industries and Mines under the late Mozambique Company; and an official of the Beira Customs Office, who acts as secretary.

Shock-Absorbing Dolphins

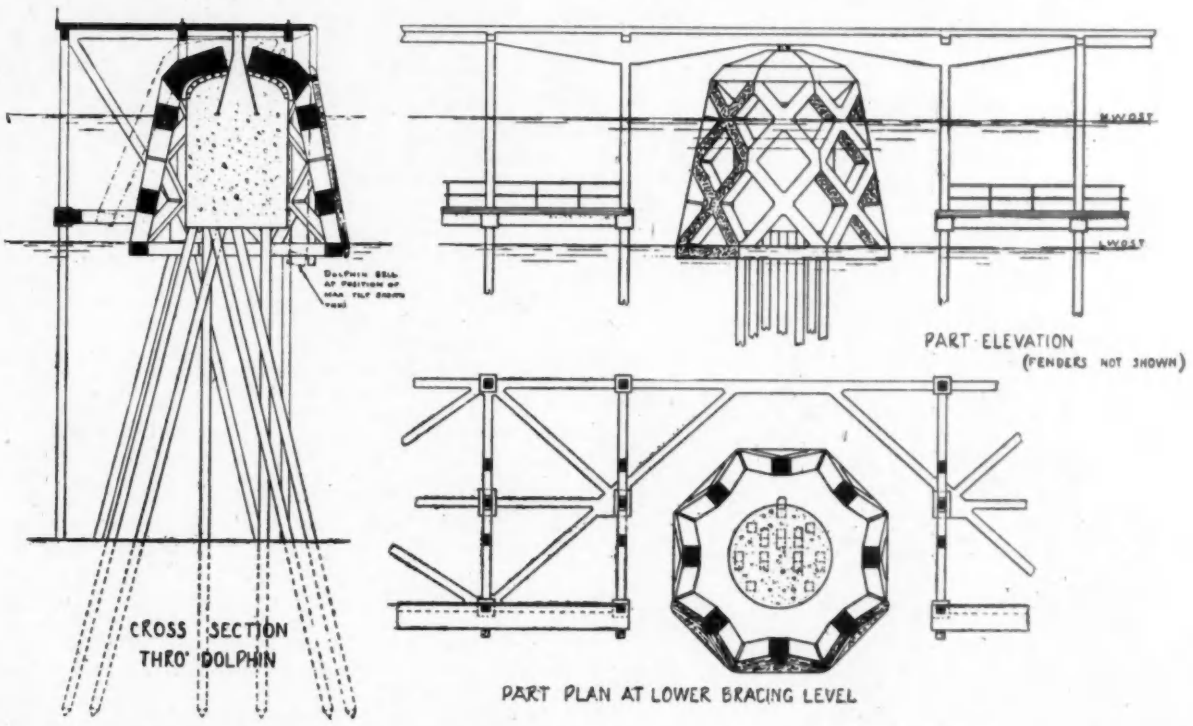
A New Design of Wharf Protection from Impact

By A. L. L. BAKER, B.Sc., Assoc.M.Inst.C.E.

Reinforced concrete has come to be considered an ideal material for marine structures except for its rigidity. In the case of a jetty or wharf this objection can be overcome by embodying shock absorbing dolphins in the construction at suitable intervals throughout the length. A description of this type of dolphin was recently given in the July, 1942, issue of *Concrete Construction and Engineering*.

The very high resilience provided by the dolphins reduces the forces of impact with ships to about 1/50th of what would normally occur with the more rigid type of wharf, thus damage to shipping can be considerably reduced as well as economies effected in the design of the wharf. The high resilience provided also makes it possible to construct jetties on sites where normally foundations would be too poor to support the forces received from the sub-structure during collisions, or on exposed sites, where more rigid structures would seriously endanger shipping.

The use of shock-absorbing dolphins is now no longer experimental since two have been tested with success on a very exposed site over a period of twelve months, with vessels berthing at frequent intervals. The dolphins are over 80-ft. high, providing for a rise of tide of 34-ft. and the moving bells weigh 150 tons. On many sites, bells constructed of pre-cast reinforced concrete ribs and weighing only 30 to 60 tons would be quite adequate. They would cost only about £20 per ton and would provide a shock-absorbing value of 1,000 to 1,500 inch-tons for only £600—£1,200, at the same time reducing the cost of the main structure.



The principle feature of the dolphin is a bell-shaped cap which bears on a spherical or ellipsoidal surface. The radius of curvature of the bearing of the cap is slightly greater than the radius of curvature of the support. Fenders are fixed to the sides of the bell, which, on receiving pressure from a vessel, recedes. Normally, the point of pivot of the bell is central, but as pressure is applied to the side, the point of pivot travels outwards, so that the resistance at the side gradually increases from zero to a force approximately equal to the weight of the bell. This provides a buffer action and by giving suitable curves to the bearings, it is possible for a bell weighing only 60 tons to absorb 1,500 inch-tons of kinetic energy while being pressed laterally to its extreme position. The bell is also free to rotate, so that the fenders recede easily from whichever direction a blow is received.

The use of such dolphins in the construction of jetties and wharves makes it possible to use very much cheaper structures as the forces of impact which can be received from ships in berthing, are reduced by the buffer action of the bells to such a degree that the decking need only be carried on a light piled structure without any fear of lateral instability when subject to blows from large vessels during berthing.

The face of the fenders and the position of the dolphins should be arranged so that when the bells are pushed to their extreme position, the fenders on the bells and on the intermediate length of wharf are in line, so that, ultimately, the pressure from a ship can be spread over the wharf throughout its length.

It is now possible, by recording the movement of such bells, to measure the blows given by ships during mooring. In one collision a dolphin has received a blow of 1,900 inch-tons without any damage occurring.

The design of the bells, their sub-structure and the arrangement of the jetty wall, of course, vary according to site conditions, plant available for construction and many other such factors. In some instances, reinforced concrete or screwed piles will be used to advantage and in others, sheet piling or cylinders forced into the sea-bed by vertical loading. In some cases, the dolphin bells will be best constructed of steel, in others of reinforced concrete, the bell either consisting of diagonal ribs or vertical ribs radiating from the top centre and connected by crossed tie-bars.

Finally, it should be emphasised that normally, a jetty can only recede about 1-in. when subjected to pressure from a ship. This new type of construction allows a movement of as much as 4-ft. to 5-ft. with a resistance increasing from zero to about 100 tons, with the added advantage that glancing blows merely cause the dolphin bells to rotate.

It should also be pointed out that shock-absorbing dolphins are self-aligning, i.e., they rotate until the face of the fenders is

Shock-Absorbing Dolphins—continued

parallel to the side of the ship. This is important, as although in a wharf, fenders may be spread over a great length, ships invariably suffer damage through glancing blows, the side of the ship very seldom touching more than 2 or 3 fenders at the time of collision.

Dock engineers have usually preferred solid heavy wharf structures in spite of their high cost, susceptibility to high wave action and dangerous rigidity. A jetty which is equipped with shock-absorbing dolphins has none of these disadvantages and it has been proved in practice that this type of dolphin alone is amply strong to withstand the most severe collisions with a high factor of safety.

The dolphin design is patented by the author and Trinidad Leaseholds, Ltd.

Power Trucks in Dock Work

(BY A CORRESPONDENT).

A great deal of criticism has recently been levelled at the war factories of this country for their failure to take advantage of the great strides made during recent years in the development of mechanical handling equipment. On similar grounds it may be asked whether methods of handling cargo are as efficient as they might be, and in this connection it may be interesting to relate an

Power Truck (Douglas type) being loaded with cargo at the Port of Glasgow.

experience of the writer's who witnessed an experiment which has been carried out by a stevedoring company at the Port of Glasgow.

During a visit to the docks in question he was shown a vessel discharging a mixed cargo, where a power truck was in use for conveyance of the goods from the ship's side to the warehouse.

In this particular case each hatch was served by one truck used in conjunction with three trailers. The cargo was dropped straight on to the trailer, in loads of 25 to 30 cwt. which was then hauled to the shed by the truck, and there left to be dealt with by the warehouse hands. It returned to the ship's side with an unladen trailer, by which the third trailer was loaded and ready for hauling. Some hatches were served by one truck using stillages.

Some very satisfactory figures were subsequently provided, giving details of an actual discharge.

	per hour
Lard:	
Average tonnage per hour, day and night	18.6 tons
During their best period of 8¾ hours they discharged the rate of	23.74 tons
Prunes:	
Average tonnage per hour, day and night	12.99 tons
During their best period of 6 hours they discharged at the rate of	17.29 tons
Barrels of Milk Powder:	
Average day and night, per hour	13.85 tons
Best period of 4 hours at the rate of	16.65 tons
Boxes of Cheese:	
Average day and night, per hour	16.98 tons
Best period of 4 hours at the rate of	22.56 tons

The foreman was very proud of a record movement from ship's side to warehouse of 219 tons of meat in 7 hours. The average rate with the aid of Power Truck was 30 tons per hour as compared with an average of 14 tons per hour using manual hauling methods.

The truck, in question, is petrol-driven and can therefore be worked 24 hours per day, if necessary. The engine is air cooled, so that freezing-up problems are absent, and being of the twin-cylinder type starting is very easy. It has a speed of 6 to 8 m.p.h., can deal with a load of 25 cwt., or with trailers on level ground up to 5 tons.

In some cases, it is more convenient to unload cargo direct on to wooden stillages standing about 20-in. above the ground, particularly where the journey to the shed is lengthy. Unloading then proceeds without waiting for the return of the trucks. In these cases, the stillages are used in conjunction with Power Trucks of the elevating type, the truck being run under the loaded stillage, and the platform of the truck elevated so that the stillage is clear of the ground. The load is then transported to the shed, and lowered, still on the stillage, to the ground, leaving the truck free to return for the next load. The elevating gear is engine-driven and controlled through a knob on the steering column, so that the driver has no need to leave the seat. Petrol consumption is dependent on work done, but a fair average is 2 gallons in 8 hours. There is no gear box, reversal of direction being obtained by rotating the steering wheel through 180°.

Correspondence

To the Editor of "The Dock and Harbour Authority."

Dear Sir,—

Destruction of Timber by Marine Organisms in the Port of Sydney

Since the Report on the above subject was compiled for publication and following the attention drawn to the matter in *The Dock and Harbour Authority*, further results have improved the possibility of the Plastic Tar Compound and the Creosote Floating Collar becoming more widely used.

These pile preservation projects were described as succinctly as possible in our second Supplementary Report, but many difficulties peculiar to each locality are bound to arise should other harbour authorities put the ideas into use. One fundamental difficulty will be to decide from biological data available whether they are better used in a complementary manner or separately. If advice from such a distance on any point connected with their use is considered worth while, then I will be pleased to help.

Near the end of an article by Eric Hardy, F.Z.S., in your September, 1942, issue, he notes that creosote impregnated timber lasts only 8-9 years in the American Pacific and Carribean Harbours. In this regard I would like to draw attention to creosote impregnated Australian Sussafras, which after 8 years' immersion is still unattacked. The locality of the test is in Sydney Harbour. The marine boring organisms are mostly Teredinine, and softwoods, including Sassafras, have only a life of 10 weeks untreated.

Yours faithfully

Yours faithfully

R. A. JOHNSON,
Preservation and Research Engineer.

Engineer-in-Chief's Office,
Maritime Services Board of New South Wales, Sydney,
26th November, 1942.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Port of Dublin

Chairman's Annual Review of Trade and Shipping

At the recent annual meeting of the Dublin Port and Docks Board, the chairman, Mr. P. McGrath, alluding to difficulties experienced in carrying on the work of the port, said that opportunities for international trade, even on a very much reduced scale, were hampered by the increasing scarcity of shipping and the extension of restrictions on export facilities in every country.

"For instance," he explained, "it had been possible to import goods from the East to Dublin via the U.S.A. and Canada, but this is no longer the case, as cargo will only be accepted at Eastern ports for final destination in the U.S. and Canada.

"It may be assumed that re-export licences for essential commodities will not now be granted.

"So far as overseas trade is concerned, the only regular sailings in operation are the services provided by Irish Shipping, Ltd., to North American ports and the steamers operated by the Wexford Steamship Co., Palgrave Murphy, Ltd., and the Limerick Steamship Co. with Portugal."

Comparing the six months, July-December, 1938 and 1942, the number of ships fell by 42 per cent.; register tonnage, 65 per cent.; tonnage of goods, 58 per cent.; ships' dues, 25 per cent., and goods dues 11 per cent.

The combined receipts from ships and goods were down by £18,306, although tonnage rates had been doubled, and goods rates increased from 112½ per cent. to 200 per cent. of the schedule.

A welcome feature in the cross-channel export trade was the revival in livestock exports, which showed a substantial decline in 1941 owing to the prevalence of foot-and-mouth disease.

On the import side, however, a very important item, namely, coal, showed a heavy drop compared with 1941.

Receipts from the higher rates in force since February 15th, 1942, had fallen far short of the estimate.

Full details of expenditure during the last 12 months were not yet available, but a preliminary examination of the current revenue account indicated a deficit of about £20,000. This compared with the deficit of £31,000 in 1941.

Enquiry for warehouse accommodation at the Custom House Docks had been very keen throughout the year. The Board had taken steps to acquire premises which were available elsewhere in the city. The building referred to was in an excellent state of repair and would give an additional 63,000 sq. ft. of floor space suitable for storage of various classes of goods. It was proposed to utilise a portion of the premises as a bonded store equipment.

The port had been well looked after and all maintenance work and services efficiently carried out during the past year.

Obituary

We regret to record the death at the age of 75 of **Mr. George S. Maskall,** O.B.E., which took place on January 10th. Mr. Maskall had spent the whole of his business career in connection with the Port of London and its shipping. He entered the service of the East and West India Docks Company in 1884, afterwards transferring to its successor, the London and India Docks Company. When this in turn was superseded by the Port of London Authority in 1909, he was appointed shipping superintendent. In 1916 he became assistant dock and warehouse manager and four years later took over control of the department as manager. He was closely connected with transport arrangements at the time of the Boer War and during the war of 1914-18. During the last war he paid official visits to French and Belgian ports on behalf of the Government in connection with facilities for handling war stores and munitions, and he also served on the Port and Transit Executive Committee which did valuable work in the relief of home port congestion. Mr. Maskall was a member of the East and West Coast Diversion Traffic Committee, and was much occupied in connection with various Government committees, such as the Sugar Commission, the Wheat Commission and the Ministry of Food. For his services he was awarded the O.B.E. He retired in 1930.

Another death to be recorded is that of **Captain E. W. Harvey,** M.B.E., R.N.R. (retired), less than two years after his retirement from the position of dock master and outdoor assistant at Southampton, where he had spent nearly 30 years of his active career in shipping service. In 1904, upon the death of his father, he was made dockmaster at Avonmouth. He was moved to Southampton in 1912. Captain Harvey was a member of the Southampton Harbour Board until his retirement, and was a Younger Brother of Trinity House, as well as an Associate of the Institution of Naval Architects.

The death was announced last month of **Mr. Andrew Don Swan,** M.Inst.C.E., a prominent Canadian engineer. He was long associated with the design and execution of port and harbour works in Canada, especially at Montreal and Vancouver, at which latter place he was Consulting Engineer to the Harbour Commissioners. He retired in 1936. Latterly he took up residence in this country and at the time of his death he was Regional Works Adviser for Scotland.

The death has also taken place, at the advanced age of 80, of **Dr. Ing. George Henry de Thierry,** a distinguished German engineer, for many years honorary president of the Hafenbautechnische Gesellschaft (Harbour Construction Company). From 1886 to 1903 Dr. de Thierry was in the service of the Hansa City of Bremen, being concerned with the construction of port works and the regulation of the Lower Weser. In 1903 he joined the staff of the Berlin-Charlottenburg Technical College, his subject being port works and waterways. He was elected president of the Hafenbautechnische Gesellschaft in 1914.

The death has occurred of **Captain William J. Hutchinson,** of Whitehead, Co. Antrim. He began his seagoing career in 1872, later entering the pilotage service of the Belfast Harbour Commissioners, being pilot master for a number of years. Subsequently he was appointed assistant harbour master, from which post he retired in 1921 after more than 40 years' service with the Harbour Board.

New Thames Bridge in Commission.

Pedestrians have been able to use the new Waterloo Bridge over the River Thames since December 21st, when the new footways were opened and the temporary bridge was closed to pedestrian traffic. The east side of the bridge was opened to vehicles on August 11th. A description of the bridge was given in the October issue.

Publication Received.

There has been issued by the Medical Research Council from H.M. Stationery Office, at the price of 4d. net, a very useful *Guide to the Preservation of Life at Sea after Shipwreck.* It gives the result of lessons learnt from the long practical experience of nautical men, with the conclusions reached from experimental work. It is, therefore, a valuable source of information which should be of the greatest service to mariners and others confronted with the dangers of the sea.

Canal Development in United States.

A new Canal, about 25 miles in length, is being undertaken by the United States Army Engineers, from the existing Industrial Canal, East of New Orleans to the Rigolets. The new work will eliminate 9 miles of the intracoastal waterway, comprising awkward bends and other obstacles. Nearly 8 miles of the total length is already excavated, the completed portion being 30-ft. deep. The remainder of the canal will be 12-ft. deep and 150-ft. wide. The estimated cost is rather over 3 million dollars. The enlargement and straightening of the waterway between Corpus Christi, Texas, and Apalachee Bay, Florida, will involve an expenditure of 15 million dollars. This canal connects with the Industrial Canal at a point about halfway between the Mississippi River and Lake Pontchartrain.

APPOINTMENT FULFILLED - THANKS TO *Smith* CRANES

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